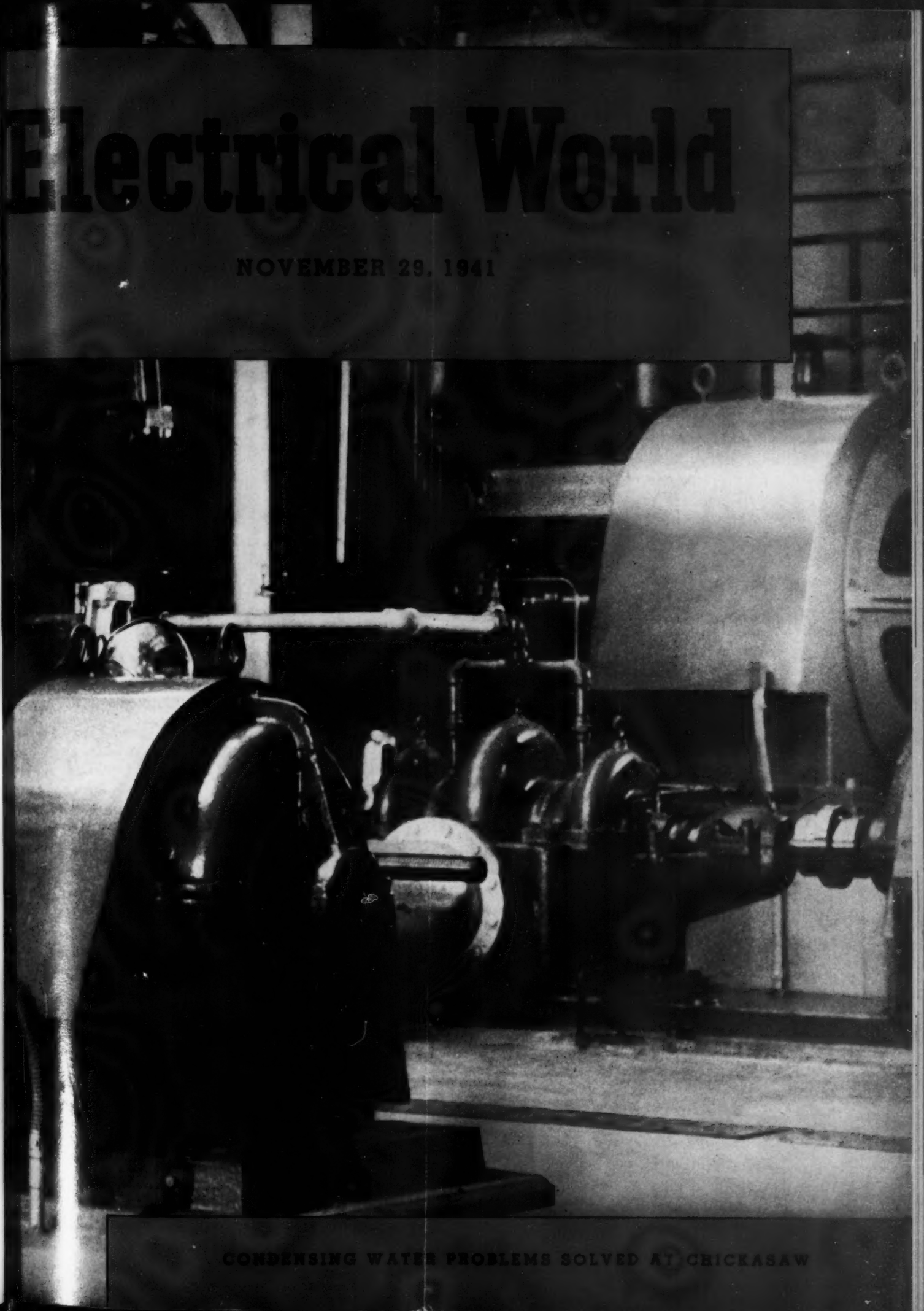
Electrical World

NOVEMBER 29, 1941



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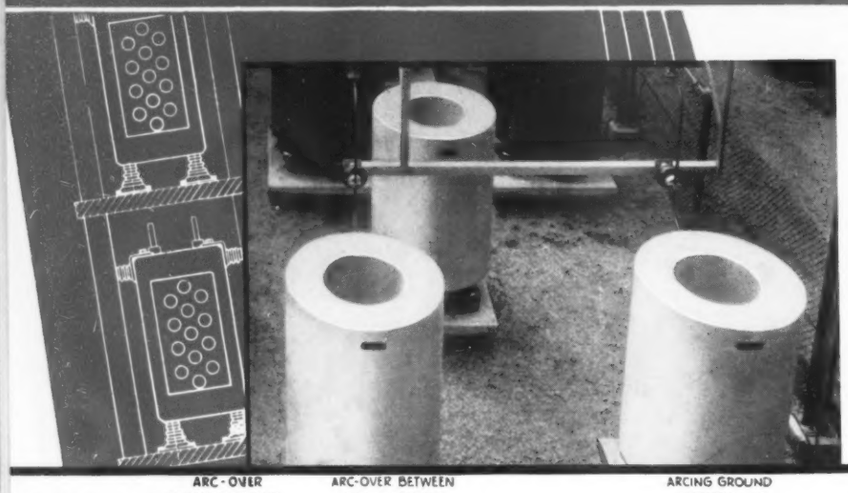

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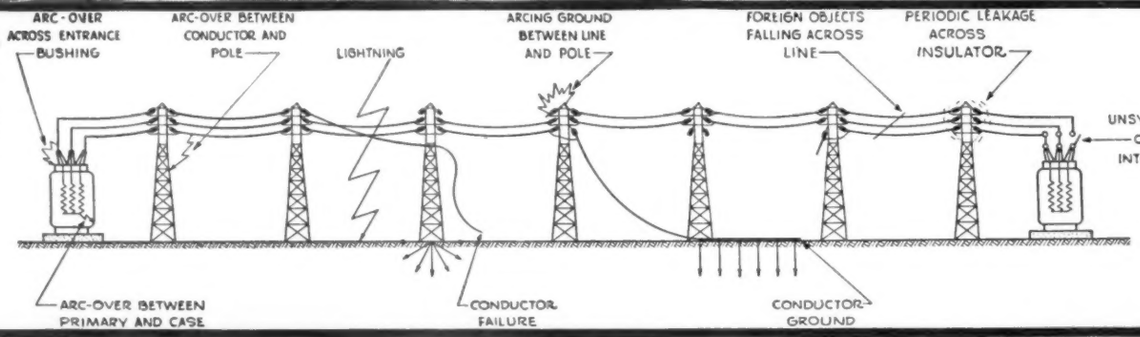

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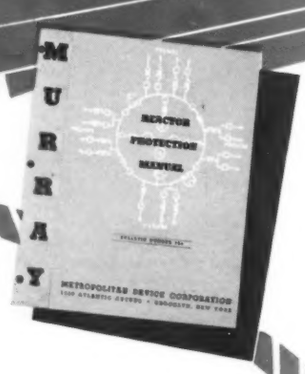

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November 29, 1941

Contents

Vol. 116, No. 22

Distribution Problems in Cantonments 40

Circuit-Breaker Analyzer Diagnoses Hidden Maladies 44
EARLE A. CRELLIN, *Pacific Gas & Electric Company*

Street Lighting in Lorain Follows Progressive Plan 46
E. J. BURGER, *Ohio Public Service Company*

Systematized Surveys Reveal Network Load Conditions 48
R. W. COURSEY, *Oklahoma Gas & Electric Company*

Glareless Illumination for Instrument Boards 51
EDWARD D. TILLSON, *Commonwealth Edison Company*

Chickasaw Plant Solves Unusual Condensing Problems 53
E. C. GASTON, *Commonwealth & Southern Corporation*

Pick-Up and Resistance of Counterpoise Systems 56
W. W. LEWIS, *General Electric Company*

Kitchen-Planning Service as a Load Builder 58
HENRY C. JOHNSON, *Connecticut Light & Power Company*

Washington Comment 62

News of the Week 63

Editorials ..... 39 and 60
Field Operating Practices 72
Industrial Engineering 78
Load Building 82
New Engineering Ideas 86
New Equipment 92
News About People 95
Manufacturing and Markets 98
Sales Opportunities 100
Letters to the Editor 104
Recent Rate Changes 104
Rural Allotments 107

Index of Advertisements 110

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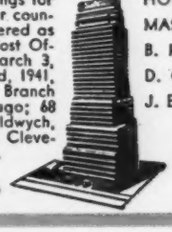

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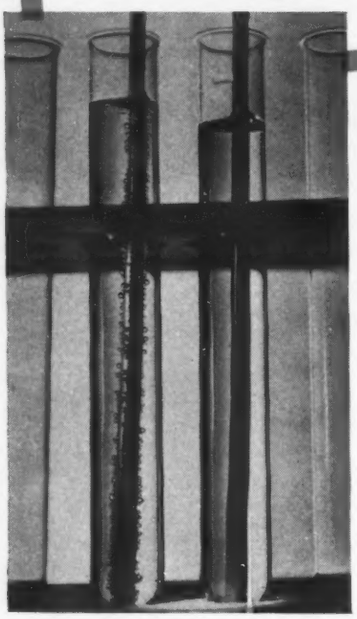
OKOLOY COATING FOR CONDUCTORS OUTLASTS "TINNING" 2 TO 1



In dilute sulphuric acid, the tin coating (at left) is attacked immediately, while Okoloy (at right) is highly resistant. This illustrates what goes on under rubber insulation in the presence of moisture.

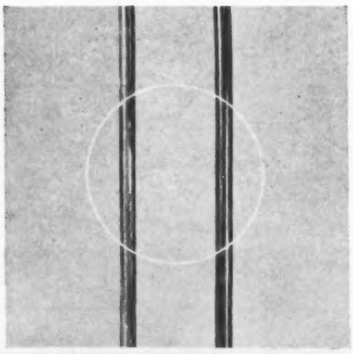
All copper conductors must be coated or covered to prevent direct contact between the copper and rubber insulation because:

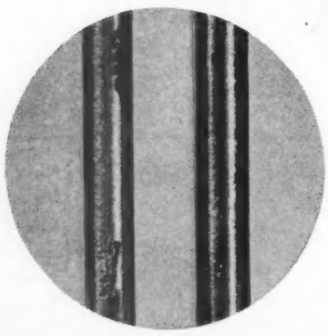
1 Copper is easily corroded by sulphur acids, formed from the action of moisture on the sulphur or sulphur compounds essential to vulcanization.

2 Rubber becomes contaminated when in direct contact with copper and deterioration results.

"TINNING" INADEQUATE FOR LONG-TIME PROTECTION

The necessity for protection has been recognized for many years and treated largely as a necessary evil. The use of tin, applied by passing the copper conductors through a bath of molten tin, dates back almost to the start of the insulated wire business. But "tinning" afforded inadequate protection, especially when wires were subjected to even small amounts of moisture. Failure of the tin coating too often has led to premature destruction of expensive cables.





Comparative tap water immersion test on Okoloy and tin-coated, rubber-insulated wires (left). Note the corrosion and almost total loss of tin and pitting of copper shown more clearly in the enlarged section. Note also that Okoloy is unaffected by the same exposure.

OKONITE RESEARCH HUNTS FOR BETTER SOLUTION

So Okonite research chemists undertook to locate the causes and develop something better.

They found two sources of the trouble. First, the reaction products, formed when sulphur acids come in contact with tin, dissolve in the acids, so that, eventually, the copper itself is exposed, no matter how good the tin coating may be.

Second, the tin coating is seldom as good as it should be, because tin and copper form

OKONITE

Precedents

When President Murray told the CIO convention last week that national defense could not get in the way of labor's job of organizing workers the American people saw red. Since when could any body set its own aims and ambitions ahead of national defense?

A little reflection, however, would show that perhaps this isn't a novel idea. The precedent for putting defense second or for using it to further non-defense purposes that have no other chance of realization has been set by many government agencies.

At this very moment, for instance, as will be seen by a perusal of the Washington Comment in this issue, REA is out gunning for the head of the power division of OPM simply because it is being prevented from getting materials to build lines for which it can show no dominant defense need.

The country is well aware of the spectacle of the President insisting on St. Lawrence development to the point of resorting to any political expedient, such as an omnibus bill, to get under the cloak of defense what has always been turned down in peacetime. Surely it is of some consequence that this project, if authorized, will require vast quantities of precious steel and copper.

In Dallas, where the need is so great that a high priority was granted for a new turbogenerator, the city has taken advantage of the critical situation to refuse permission for installation until it gets certain concessions, hoping thereby to produce a stalemate so that the public eventually will vote for municipal ownership.

SEC refuses to let defense considerations in any way interfere with its administration of the Holding Company Act. It seems almost axiomatic that pending change in ownership would be a deterrent to expansion.

The Arkansas aluminum load is due to be ready next spring, with no contract yet signed for power to take care of it until its own generating units are installed, some time in 1943. Although a very favorable contract from companies with a large reservoir of power is ready for acceptance, the whole thing is held up and the production of aluminum will probably be delayed because REA wants part of the load.

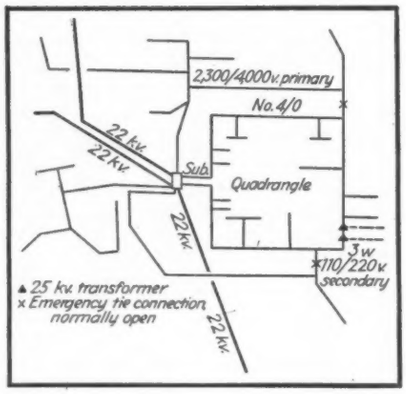
None of these government agencies or officials has been punished for its attempts to take advantage of national defense. In fact, in the instance of REA, the powerful public power congressional bloc has egged it on to greater opposition.

Other industries in all probability have other examples of administration unethical use of defense to gain some selfish end. And it is this very flouting of defense by the very people who should do all in their power to make it stronger that serves as a precedent for organized labor also to employ defense to serve its selfish ends.

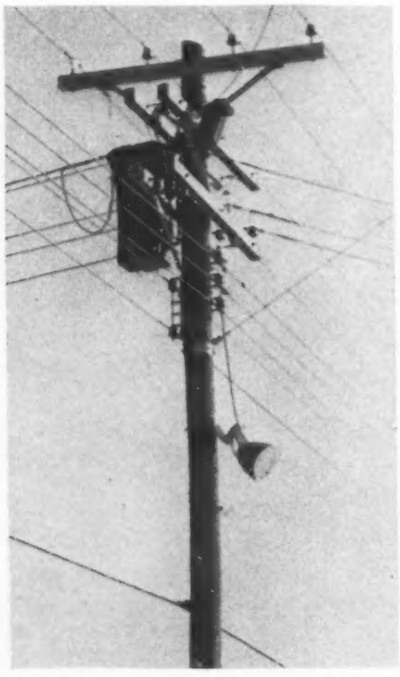
While labor cannot be excused for its defiance of national defense, we hold that if it is the patriotic thing for labor to stay in *status quo* with respect to furthering its organization policies until the emergency is over, then it is even more essential that government remain in *status quo* with respect to public power policies and other nationalization schemes until peace is declared.

Distribution Problems in Cantonments

Speed in construction and facility in maintenance governing factors in layout — Conventional practice valuable aid to reliability of service



SCHEME of primary energy supply in typical cantonment unhampered by irregular terrain



TYPICAL distribution transformer hung on double buck arms, with floodlight unit for street traffic

IN TYPICAL army cantonment construction from which lessons of value to the electrical engineer may be drawn—and this without captious criticism of men under heavy pressure to achieve results as rapidly as possible—it might be thought that the problems of design would be greatly simplified. A representative project called for erection of 1,400 buildings at one time. It was at first blush assumed that because there would be a minimum of guessing as to loads, future growth, other utilities required, road construction, etc., the designer of the distribution system might hereby achieve perfection of layout. Experience was quite to the contrary.

In Camp "A," which we may call it, layout, design, engineering and construction proceeded simultaneously. Approval of building locations preceded their actual construction by a short period; in some cases by only a few hours. Building erection in the main was on a 24-hour basis. The contractor operated numerous portable lighting plants, using a small amount of temporary line, but the great part of the floodlighting required was supplied from newly erected and permanent lines. Upon completion of buildings, floodlights were in general removed and building services run.

Pole and guy locations were dependent on service locations as prescribed in the building wiring plans previously prepared by the Army engineers—upon future truck driveways to certain building entrances, upon outside chimney clearances on certain buildings, upon trenching machine clearance for sewer and water construction to follow, on telephone requirements and upon possible future extensions to other areas.

Distribution design and layout met the swift pace required only by a freedom from formality in contacts between personnel. Line superintendents and foremen visited the engineering office repeatedly, and engineers and draftsmen took part in field conferences with line foremen. In spite of the large number of verbal instructions and hasty sketches used in starting a job of line work, finished drawings and specifications were invariably issued before its completion. No difficulty was found in keeping the work up to the standard agreed upon, and the extent of relocations and changes due to haste was negligible. The electrical contractors maintained seventeen fully equipped line crews of fourteen men each during the major part of the work.

Energy From 22-Kv. Loop

Energy supply at the outset was simplified by the approximate bisection of the camp site by a 22-kv. central station system line on an existing right-of-way. A later tap was provided from the opposite side of a transmission loop of which the above line formed a part. Initially, the power company loaned the camp an 1,800-kva. transformer unit with self-contained automatic tap changers and secondary breaker, which was used to energize the first sections of 2,300/4,000-volt Y-connected primaries erected for the project. As this primary system grew, it soon reached the point where it became physically feasible as well as electrically desir-

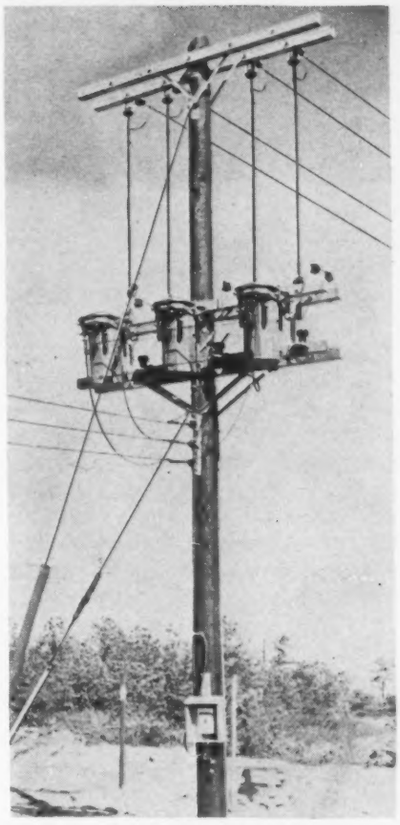
able to divide it into two feeders, and this was done by supplying one feeder from a bank of three 500-kva. transformers, also loaned by the power company. Still later, these feeders were regrouped and a third supplied by one of a number of new units purchased for a permanent substation. The site of the permanent substation had been selected by this time, and the construction of primary lines so arranged that they ultimately were divided into five separate feeders all radiating from this site.

Quadrangle Construction

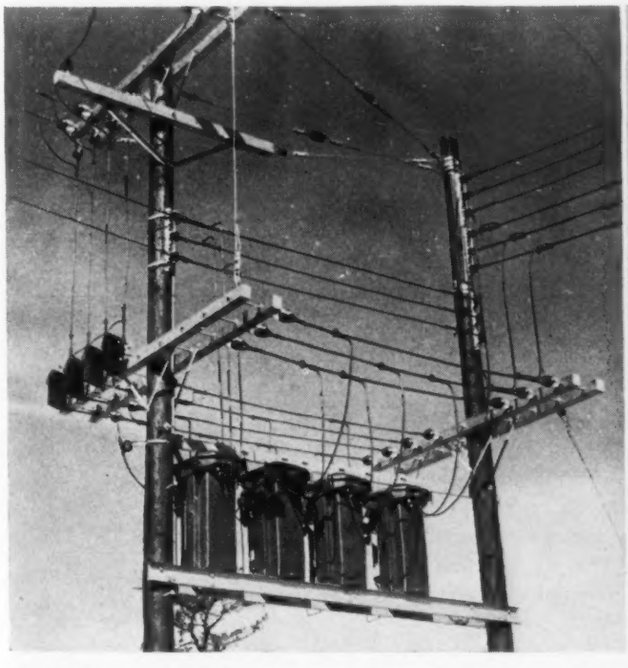
When line work began the project was known to consist of a so-called quadrangle. This was represented by a paved road forming a square, a mile on each side. On both sides were to be several rows of buildings. (As finally built, there were five rows on the inside, with a few miscellaneous structures forming a sixth, and from three to five rows on the outside.) The first primary feeder construction was a line around the quadrangle. Four No. 4/0 bare, hard-drawn, stranded copper conductors were installed on 40-ft. class 3 creosoted pine poles except at corners, where 45-ft. poles were set. Crossarms were 4x5-in. untreated fir, six-pin, using steel nut pins with lead cobs in the end and pole positions. As drop-angle braces were used for greater strength, due to sleet prevalence in this region, the middle pin position was used for the brace bolt. Pole spacing was determined by building spacing in order to run taps into the lanes between. The usual standard was two 29.5-ft. buildings spaced 50 ft. apart, which resulted in spans of 159 ft. except in fire breaks and approaching corners. Outside the quadrangle spans average between 125 and 150 ft.

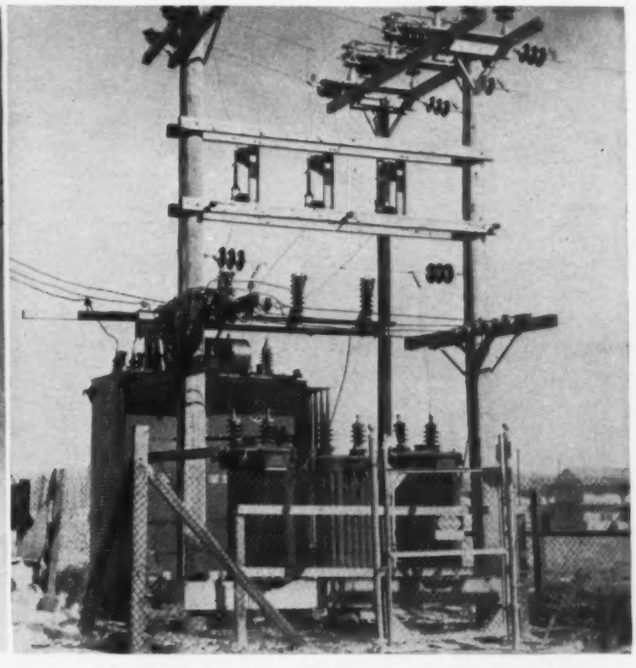
The advisability of operating a primary network was considered, as well as various network and banking schemes for secondary distribution. It appeared possible that enlisted men might be used for maintenance and operation, with a considerable turnover of personnel. This led to the conclusion that the design should adhere both physically and electrically to more or less commonly accepted standards, with all primary feeder and secondary crib layouts radial and all connections, directions of feed, etc., simple and obvious to quick visual inspection. Cutouts were mounted on the opposite side of the pole from the transformers and close to the pole rather than on the end of the arm.

As the building wiring plans showed lighting outlets only, estimates of power and appliance loads were made and a slight diversity factor allowed between them. Between similar buildings no diversity was allowed due to anticipated regimentation of military activities. On the quadrangle, however, the buildings on the outer side were all barracks,

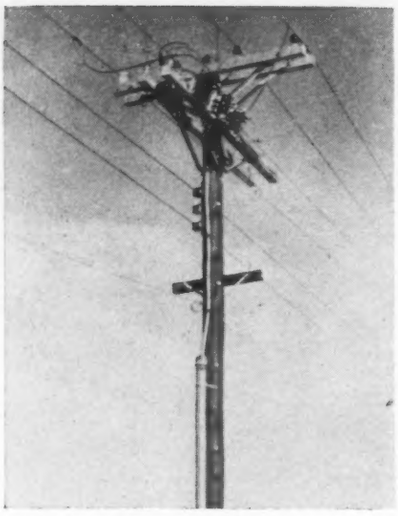


TRANSFORMER BANK and take-offs for temporary service and construction power





TWO-POLE STRUCTURE for permanent supply to bakery (left). Temporary substation for service during construction period and pending completion of permanent metal-clad substation (right)



TYPICAL underground primary service used to supply cold storage plants, hangar, etc.

those on the inner side being miscellaneous and service buildings, including mess halls, day rooms, infirmary, recreation hall, guard house, post exchange, storehouses, officers' quarters, regimental headquarters and administration buildings. It was felt that considerable diversity might be relied upon between the inner and outer sides of the quadrangle.

Accordingly connected load totals were prepared for groups of buildings consisting of two rows at right angles to and crossing the roadway. These figures varied somewhat due to the estimated demands of miscellaneous buildings, but tended to average between 30 and 35 kva. each. It was then decided to adopt 25 kva. as a standard transformer size for the quadrangle and to hang one of these on each pole along the main primary line (except in fire-breaks and approaching corners). Secondaries were run at right angles to the primaries in both directions to both the extreme inner and outer ends of each alternate lane between rows of buildings. Under this plan the longest secondary runs do not exceed 600 ft., and conductor sizes were standardized at one No. 4 and two No. 2 weatherproofed hard-drawn copper. Exceptions are secondaries added later for multiple fire alarm lights and individual multiple street lights, which are two No. 6 weatherproof. Practically all buildings were provided with three-wire layouts and most of the service drops are three No. 6 weatherproof, a few of the larger buildings having one No. 4 and two No. 2 drops.

The use of 25-kva. transformers was later extended, partly to simplify maintenance, over virtually the entire system. Twelve 10-kva. transformers from an old distribution line on the site were utilized in three-phase, single-pole banks for shop, pumping and other facilities.

Future Expansion Affected Design

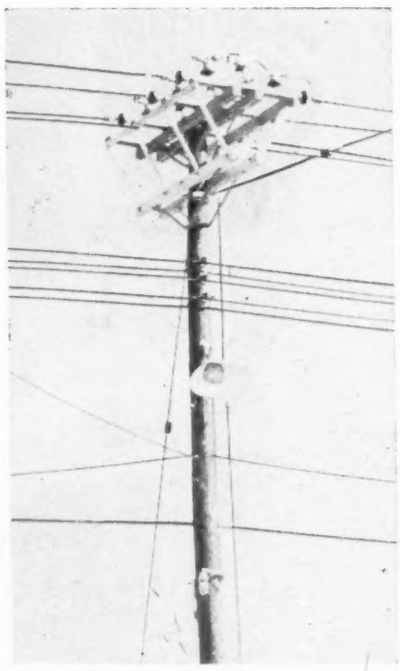
Considerable thought was given in relation to possible load expansion due to authorization of additional buildings or appliance loads and their effect on transformer locations and capacities. With this in mind, no transformers were hung on line arms, but were hung on double buck arms under the single line arms. The third gain was used for another double arm serving as a transformer kick arm and also for secondary mains which rolled to vertical spacing on three-spool, 8-in. racks. The top gain was left clear for possible future primary taps. With this type of transformer pole assembly it became easy to take off a primary tap in either direction from any pole without changing any existing construction.

Developments proved the wisdom of this plan as anticipated additions appeared. A sixth row of buildings was added later along parts of the inner quadrangle. Some of these were officers' residences with electric ranges, and to serve these No. 4 primary taps were run over the previously built secondaries to appropriate transformer locations. A dental clinic with 34 kva. connected load was handled in the same way. It also developed after the quadrangle distribution was built that the mess halls would each have a 7-kw. deep fat fryer. At first it looked as though this would require replacing 34 of the 78 25-kva. quadrangle transformers with 50-kva. units. It was felt, however, that the use of this larger size involved serious considerations of weight for pole tops, difficulties of replacement and greater danger in fusing, especially in view of the doubtful caliber of the maintenance arrangements. This situation was met by building 34 short primary taps crossing the street from the main primary line to the first poles of the inner secondary runs. These secondaries were transferred from racks to double arms in the second gains and run through toward the inner buildings. Then 25-kva. transformers were hung on the first gain double arms which also deadended the primary taps. Secondary leads were also brought down to a rack position and connected to mess hall services, but not to the secondaries running through on the arms. By one additional span parallel to the road two more mess halls were picked off the lighting secondaries, making four to each transformer.

An incidental advantage of this arrangement is that the load of a defective transformers can be picked up on other secondaries without running additional wire. This was felt to be of considerable value, first, for emergency restoration of service by limited personnel, pending later replacements, and, second, in case of a partial or complete evacuation of the camp or of one regimental area such an area can be supplied entirely from a single transformer with sufficient capacity for watchman service and light repair work under reduced core losses.

Sectionalizing

Gang-operated pole-type air-break switches were adopted for primary sectionalizing, but could not be located until the site of the permanent substation and resultant point of feed to the quadrangle could be settled. Therefore in building the quadrangle line a number of points of sectionalizing were selected and double arms



SECTIONALIZING switches in primary feeder on quadrangle

and dead-end construction specified. Three of these points on the quadrangle were eventually chosen for switches, but others proved valuable for opening the line during construction.

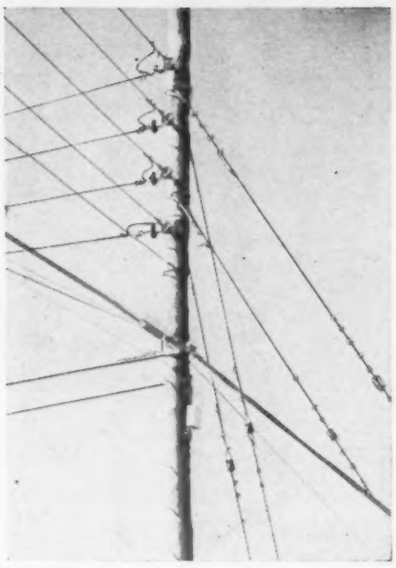
While quadrangle construction was under way other parts of the project, with their sudden demands for temporary power, were begun. Lines were run from the quadrangle feeders to a sewage treatment plant and two deep wells (four No. 2 bare hard-drawn copper on 35-ft. poles). Two-pole structures were provided for certain permanent service, all being designed to accommodate four 50-kva. transformers, though at the wells, where only a single-phase capacity was required, three transformers were used.

More than 3,000 kva. in connected transformer capacity was installed for quadrangle service. Branch feeders decreased in size from the No. 4/0 section used on the main loop through No. 2/0 and 0 to No. 2 for certain loads. Provision was also made for emergency services to certain areas by taps from particular feeders and connections arranged to permit normal openings between certain looped sections under the radial distribution scheme used. In general, all electrical distribution is overhead except to two cold storage plants, ordnance shop and an airplane hangar.

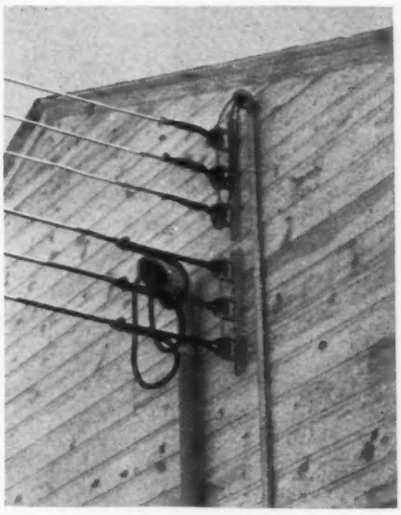
Experience indicated considerable risk of future pole replacement if heights or pole classes were cut down, since requirements for communication purposes greatly exceeded the original estimates. Telephone plant was installed by forces from that utility through arrangements with Army engineers on poles provided by the electrical contractor as part of the electric distribution project. The result was that a number of additional poles and many more guys to existing poles were required for telephone purposes. A fire reporting telephone system was laid out using telephone circuits and having 24-hour multiple lamps at each box.

Service Entrances

These requirements involved both additional secondary space and telephone space. Many of the standard mobilization buildings are low and difficulty was experienced in maintaining drop leads at suitable height, especially on account of the frequent movements of heavy automotive equipment and artillery. Again, government wiring plans often specify service pipe location at a point where the full height of the building is not utilized. Where inside wiring contracts have been based on such plans, changes may involve extras and in any case require considerable attention. Some saving in distribution cost might have been effected had latitude in service entrance locations been provided in the wiring plans to afford a more efficient use and location of pole plant. It was found that Signal Corps activities resulted in the attachment of large numbers of communication circuits in temporary and semi-permanent construction on many poles, and that any or all poles may be subjected to climbing practice by Signal Corps recruits.



VERTICAL spacing of dead-ends at point where anchors only could be used instead of double arms



DEAD-ENDING drop leads on racks attached to building; feed to interior through rigid conduit

No plans for street lighting were approved until the project was well along, when it was decided to use the floodlighting fixtures already in hand from the construction work. These were provided with 100-watt multiple lamps on extenders and were in general located to connect with existing secondaries through individual switches brought down the poles in ½-in. conduit and mounted in a cast-iron, waterproof switch box. These switches are operated by sentries, and the lights are intended to aid main traffic. They were not located in the lanes between buildings where considerable outdoor illumination exists from windows and doorways.

Dead-Ending

Heavy conductors were dead-ended at corners on double arms where arm guys could be run horizontally to stubs. Where anchors only could be used, dead-ends were spaced vertically on the pole. Although this construction proved physically sound, it fails to offer the opportunities for phase transposition or easy removal of jumpers, such as are offered by flat corner construction.

In general, emphasis should be laid upon the importance of locating poles, arranging circuits and designing pole tops so as to provide for all possible additions or contingencies without dismantling completed work or killing circuits. In addition to the permanent feeder sectionalizing points provided, frequent dead-ending of primaries where jumpers could easily be removed was found to be worth while. Maintenance of interrupted service was recognized as of great importance from the moment of first energizing the initial section of the project. A failure of service at the temporary construction power and lighting outlets would have resulted in a tremendous loss of time through delay to great numbers of workmen. As construction moved on to new areas troops were moved in to completed buildings, so that no relief from this responsibility was had.

In the substation design, to facilitate construction and maintenance the usual mat type of foundation was superseded by building two longitudinal concrete walls (for 1,500-kva.

[*Continued on page* 104]

Circuit-Breaker Analyzer Diagnoses Hidden Maladies

Device speeds up maintenance, insures better operating characteristics and permits keeping a permanent history of breaker operation

EARLE A. CRELLIN, Pacific Gas & Electric Company, San Francisco*

PROPER MAINTENANCE of an oil circuit breaker requires a means for determining the speed-time characteristics of the contact mechanism. Various methods have been devised for field determination of these values, but the Pacific Gas & Electric Company is now successfully using an analyzer devised by Earl Whitely of the company's protection engineering department. This device provides a graphic chart.

The performance curves for types of breakers can be prepared and the important factors in their operation visually presented for study and analysis. The analyzer is being used during maintenance operations on all breakers on the Pacific Gas & Electric system and the resulting records are being filed for comparison with future performance records.

Breaker contacts become pitted due to arcing action and the operating mechanism becomes slowed down due to weakening of springs or accumulations of dust or gummy lubricant residue in the bearings and on moving parts. After complete disassembly and overhaul the breaker should continue to meet interrupting guarantees if the work done is correct and if all parts have been restored to their original condition. But a ready means

* Assistant engineer of maintenance.

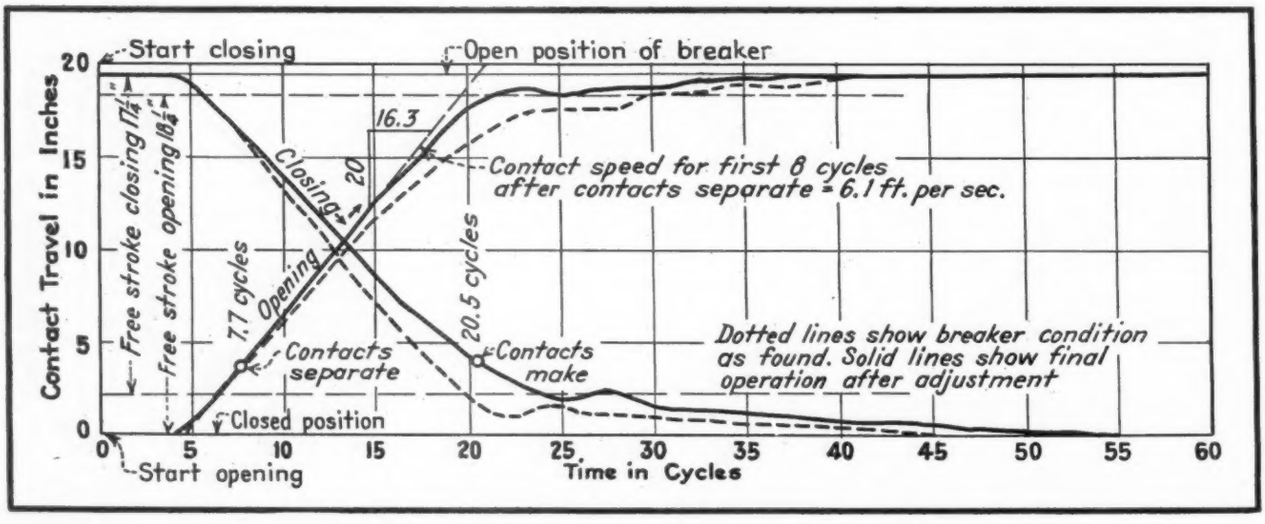


CHART from circuit breaker analyzer showing operating characteristics before and after maintenance for a 20-year-old, 400-amp., 15,000-volt breaker

Opening and closing times were corrected. Elapsed time between trip coil energizing and actual parting of the contacts was 7.7 cycles as measured by the cycle counter. By plotting this point on the curve it was possible to determine the speed of contact travel after separation of the contacts. From the slope of the curve this was calculated as 6.0 ft. per second for the first 8 cycles after contact separation, which is well over the acceptable speed for such a breaker.

The circuit breaker employs both springs and motor for full contact travel. The amount of "free stroke travel" (spring actuated) is an important point to check on this type of circuit breaker. This was determined from the chart by operating the circuit breaker with the motor circuit open.

In preparing this chart it was determined that the actual measured full contact movement for this breaker was 19⅜ in. This established the vertical scale. The opening free stroke was then scaled off as 18⅛ in., or about 97.3 percent of full stroke due to spring action alone. This point was reached in 21.6 cycles and full contact travel in 43 cycles. The free stroke on closing was scaled off as 17¼ in., or 89 percent of full stroke, the lesser travel being due to the resistance offered by the contacts, which begin to close after 15¾ in. of travel.

is needed to determine if the mechanism is operating at the desired speeds on the opening and closing strokes.

Adjustment for Speed

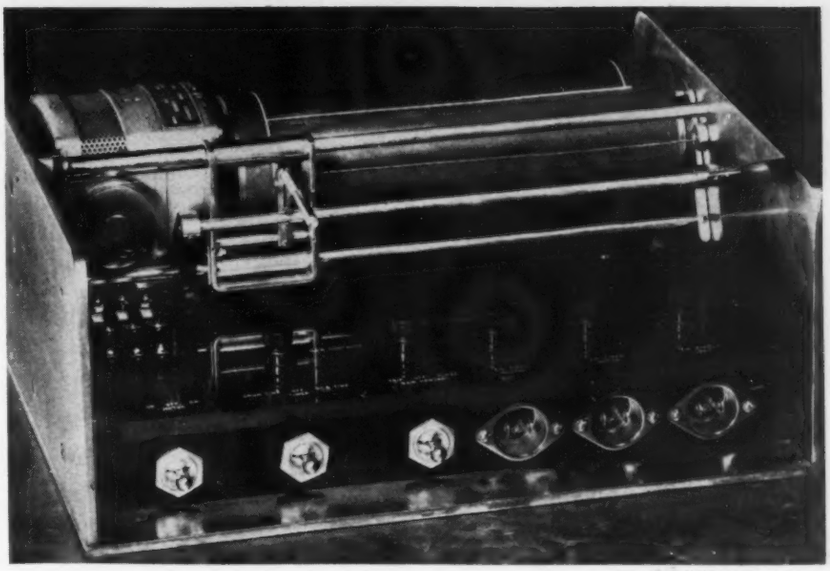
Construction of some types of breakers permits wide latitude in the adjustment of opening and closing speeds. Frequently the speeding up of the closing stroke to gain faster response for synchronizing will slow down the opening stroke and seriously affect the current-interrupting ability. Use of the analyzer permits adjustments to secure proper speeds in both directions. Also, many breakers have buffer springs which are compressed on the closing stroke for the double purpose of cushioning the operation of the mechanism and acting as kick-out springs to speed up the initial opening motion.

If the buffer springs are too stiff they may check the closing motion prematurely or may cause the mechanism to rebound, with possible reopening of the contacts and damage by arcing. If the springs are too weak the closing shock will not be properly absorbed and there will not be sufficient energy available to accelerate the mechanism on the opening stroke. All of these conditions will be indicated by the analyzer chart and adjustments can be made to assure satisfactory breaker operation.

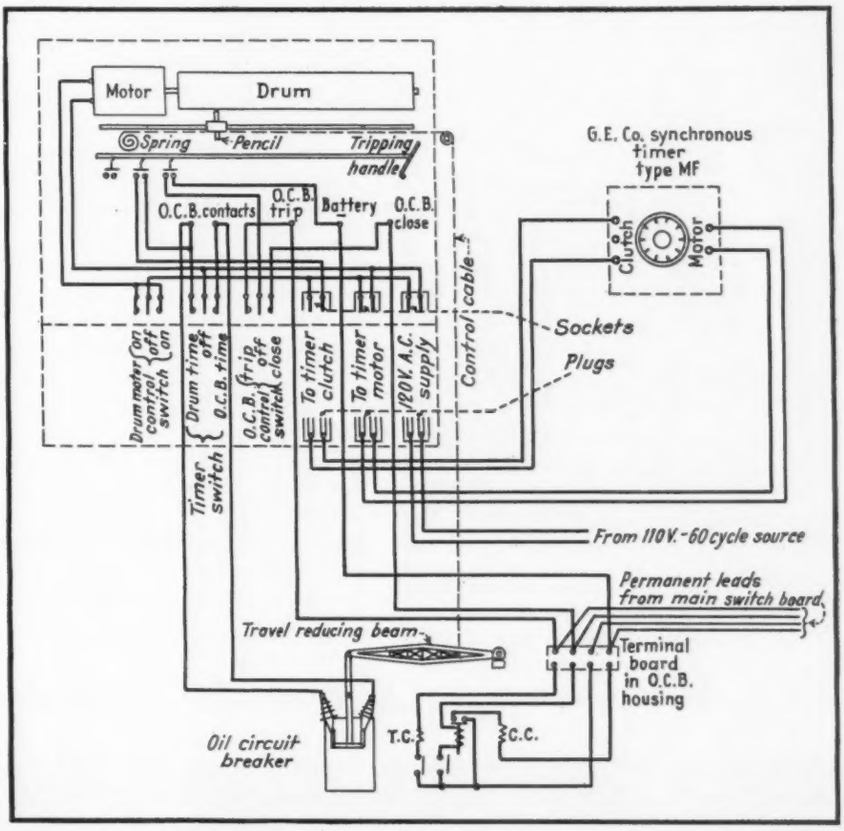
Trace on Drum

Basically, the analyzer consists of a paper-carrying drum driven at constant speed by a synchronous motor to which the record of breaker operation is transferred by a pencil mechanically connected to the breaker mechanism and moved in synchronism with the movable contacts.

In testing, the drum revolves continuously as long as the drum motor switch is closed, but the pencil is only in contact with the paper for a single revolution. If the full stroke of the breaker requires more than 30 cycles it is possible to keep the pencil on the paper for two or more revolutions. The same operation that applies the pencil to the chart completes the circuit to the breaker tripping or closing coils. By inserting a cycle counter into the circuit the actual instant of contact make or break can be determined and plotted on the chart.



WHEN A SHEET of 8½ x 11-in. coordinate paper is fastened to a revolving drum and this analyzer is hooked to a circuit breaker a curve is produced showing breaker performance and characteristics. The drum diameter was made 3.183 in. to give a circumference of 10 in. With drum speed at 120 r.p.m. a single revolution of the drum is made in ½ second or 30 cycles (60-cycle source). The 10-in. length of the chart is divided into 30 parts, each representing one cycle



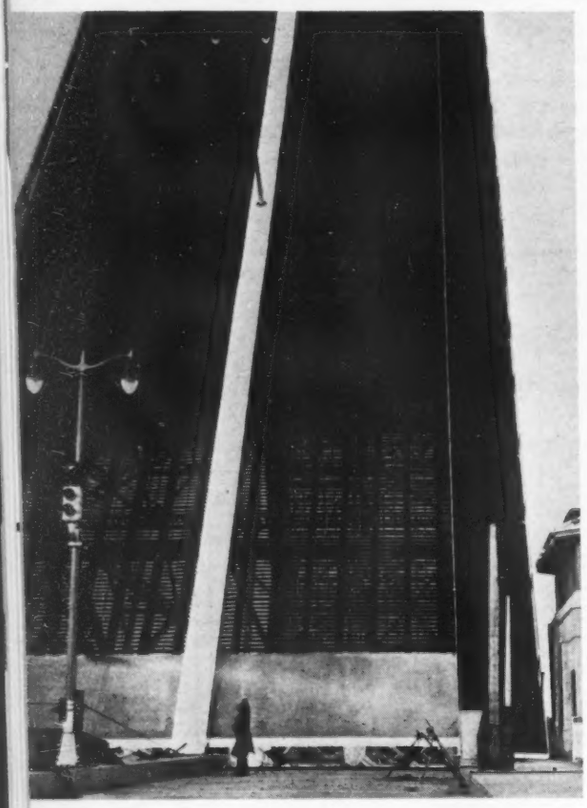
SCHEMATIC DIAGRAM of internal and external connections for oil circuit breaker analyzer in testing breakers

Breaker contact travel is reduced by an 8-ft. reducing beam or lever so that the full breaker stroke is represented by the pencil travel over approximately the full width of the analyzer chart. For breakers with rotating rather than reciprocating contacts the travel reduction is accomplished by attaching a control cable sheave to the rotating shaft of the main contacts. The analyzer is equipped with three Bakelite sheaves 4, 6 and 9 in. in diameter to produce proper pencil movement on chart.

Street Lighting in Lorain Follows Progressive Plan

Ohio Public Service provides 58 percent more lumens for only 25 percent increase in cost—Photoelectric control designed for multi-installation

E. J. BURGER, Ohio Public Service Company, Lorain*



MODERN BRIDGE, modern road design, modern lighting for East Erie Avenue bridge. Eighteen 1,000 c.p. lamps to provide 1.25 ft.-candles on roadway

OUR NEW "progressive plan" agreement with the city of Lorain gives the people 58 percent more light for only 25 percent more cost, retains the basic rate for added lamps and constitutes one more valuable service rendered to the public through our installation of the very latest equipment supplied through safer, more reliable street-lighting circuits and controls.

Termination of street-lighting contracts in 1940 between the Ohio Public Service Company and the city of Lorain, Ohio (population 44,000), led to studies by the company to provide both lower unit costs and increased lighting facilities. The lighting system then consisted of 1,308 units in sizes ranging from 2,500-lumen lamps to 10,000-lumen lamps, part of which consisted of a whiteway system serving the business district.

The city officials and the Ohio Public Service Company agreed on a street-lighting modernization program which included a progressive plan prepared by the utility and the General Electric Company. The company agreed to modernize about 12 miles of street lighting which would provide for 357 additional lights, requiring a total expenditure of $65,000 by the company for wire, cable, poles, fixtures, lamps, etc.

A new ten-year contract was negotiated which specified that the city would pay a lump sum annually for the 1,665 lights which would represent the completed system. The lump sum price agreed upon gave the city a substantial reduction in lighting cost when calculated upon the annual per unit costs in the old contract. It was agreed, however, that the city would pay the previous per unit rates for additional lights installed during the life of the contract, outside of those included in the modernization program:

The old system provided (lumens)	5,756,500
The new system provided (lumens)	9,072,500
Increase (percent)	58

City Bill

City's annual bill, old system	$48,215.52
City's annual bill, new system	60,387.40
Increase	$12,171.88
	25.2 percent

Cost per Lumen Year

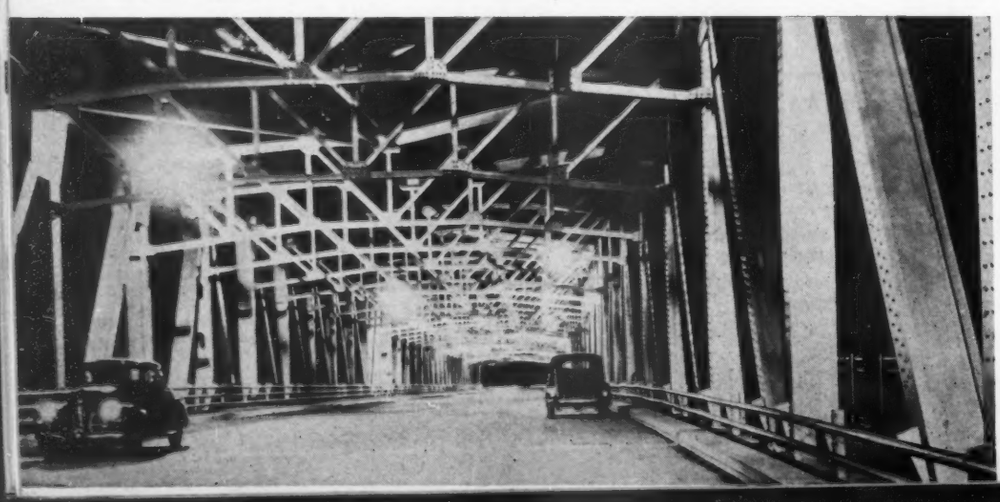
Old system (per lumen year)	$0.0083758
New system (per lumen year)	0.00656

The new street-lighting contract also provided for the consolidation of two street-lighting contracts into one. Previously the utility had one contract with the city of Lorain for lighting the streets outside the business district and another for the whiteway lighting supplying the business district.

The new lighting, as recommended and installed, conforms in all essential details with modern practice as

* Vice-president and division manager.

FORTY-FOOT ROADWAY on this high level bridge lighted by same type of sodium, mounted and spaced as in underpass



recommended by the street and highway lighting committee of the Illuminating Engineering Society. It was made possible by the type of contract agreed upon and the lower rates charged for the service.

The modernization program has had a very good effect in the way of improved relations between the customer and the utility. This improved relationship has been evidenced through words of commendation from the citizenry to both the company and city officials. Notwithstanding, the program has led to many requests for improved lighting in other sections of the city. Thus, no doubt, in time all of the lighting in the city will be made to conform to modern standards.

Bridge Lighting

An interesting feature of the new program was the lighting of two new bridges across Black River. One bridge, reputed to be the longest span Bascule type bridge in the world, was lighted with eighteen 10,000-lumen series incandescents. The other bridge, of the high level type, is lighted by means of 43 10,000-lumen sodium luminaires on 100 and 150 ft. centers.

Two types of lighting, incandescent and sodium, are involved in the changeover from outmoded and inadequate equipments to newer luminaires which provide night visibility conditions in keeping with the modern requirements of motorist and pedestrian. The incandescent luminaires now used are of the pendant type, equipped with deep shading "stepped" Alzak-finished aluminum reflectors, auxiliary deflectors and refractor globes. These luminaires should deliver as much as 80 percent more light to the pavement than did the best previous lighting fixtures. Shading of the light source greatly reduces the candle-power in directions near the horizontal, thus suppressing objectionable glare and contributing greatly to the appearance and seeing capacity offered by the new lighting system. The "stepped" reflector feature is designed to prevent a high concentration of reflected radiant energy at the luminaire axis, and thereby helps prevent premature lamp failure when larger lamps are used.

The sodium luminaires in operation are of the G.E. type M-2. This is an open-type luminaire, employing a 10,000-lumen lamp mounted horizontally in an arrangement of Alzak-finished aluminum reflectors. These produce a scientifically correct pattern of light and distribute it efficiently.

LORAIN FORMULA for modern arterial lighting: 10,000-lumen, Novalux, 20-amp. series lamp, 25 ft. mounting, 100 ft. spacing

FOR EAST 28th underpass Lorain uses type M-2 sodium, 10,000-lumen, 25 ft. mounting and 200 ft. staggered spacing

Considerable credit is due to Messrs. Hardenbergh and Reed, distribution superintendent and electrical engineer for the Ohio Public Service Company, who contributed the necessary technical studies involved in the development of the system. Salient technical features follow:

The new series circuits have constant current transformers at load centers.

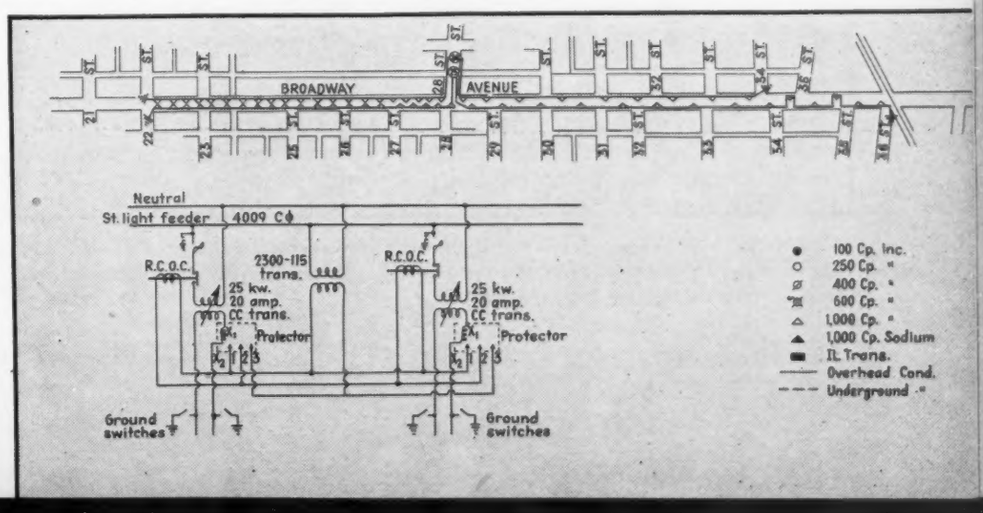
The ends of each of the circuits are grounded to primary multi-grounded neutral system. This arrangement reduces the potential of the series circuits above ground to about one-half the operating voltage of the constant current transformers.

Current transformers are controlled by photo-electric cells, and where possible one cell was wired to control several transformers.

Constant current transformers are equipped with a Novalux protector that disconnects the transformer from the primary circuit as a protection against fail-

[*Continued on page* 104]

TYPICAL street-lighting circuit at Lorain results in lowered voltage, enhanced safety, faster restoration of service



Systematized Surveys Reveal Network Load Conditions

Oklahoma utility develops systematic method for making low-cost underground network load surveys as conventional load-estimating methods lose effectiveness under erratic shifts in load trends

R. W. COURSEY, Oklahoma Gas & Electric Company, Oklahoma City, Okla.*

ACCURATE FORECASTING of load on underground network systems has become increasingly difficult in recent years due to changes in the character of network loads and the erratic shifts in existing load trends.

Air-conditioning loads in the Oklahoma City area are probably the largest single factor upsetting system load forecasts as usually made. Contributing to this condition, however, is the recent mushroom growth in the network area of small welding and machine shops, perhaps traceable to defense activity. These shops, which spring up unannounced, are as a rule small, but house a comparatively large assortment of motor-driven equipment. Frequently they are at the rear of other buildings and are quite unpretentious in appearance.

These erratic and unpredictable factors affecting network loads have caused us to have less faith in such conventional methods of locating overloaded areas as forecasts, advance on loads to be added, spot surveys, voltage surveys and field inspection for warm cables. Direct outgrowth of this situation in Oklahoma City has been the development of low-cost, systematic annual load survey methods for application to the entire secondary system to guide allocation of cable and transformer capacity.

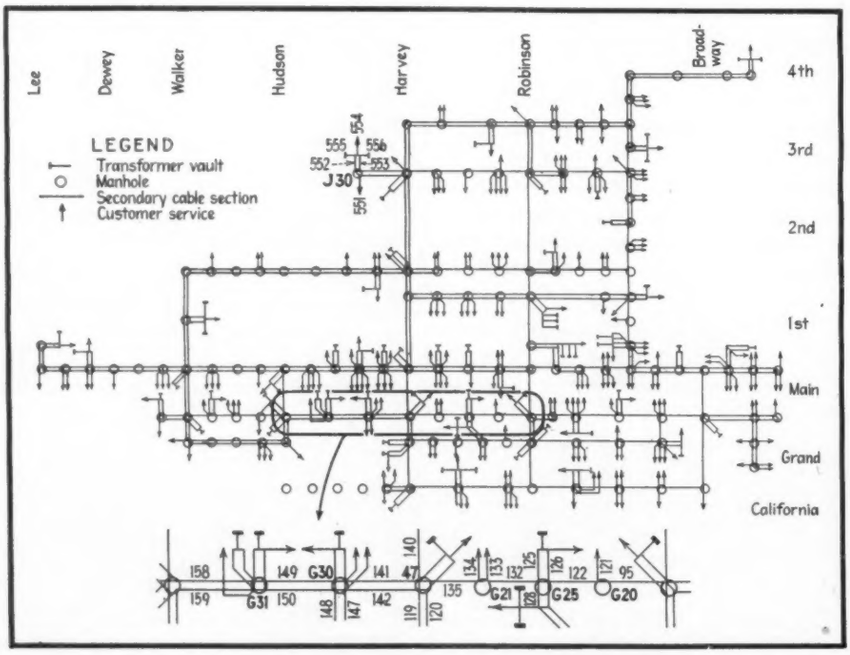
Such a periodic survey of the network system as will be described has the advantage of allowing analysis of the systems as a whole, rather than in parts. This results in more economical and practical remedial measures for overload conditions. It might show, for example, that if several transformer banks are shifted from one primary supply to another overloaded transformers might be relieved without adding new capacity, whereas spot load checks might indicate the need for additions.

Network system secondary grids lend themselves to systematized methods of collecting data, since a comparatively few procedures can be repeated successively until the whole system has been covered. As a rule, 80 percent of the readings can be taken in manholes and 20 percent in transformer vaults.

Frequency of Survey

Frequency with which such surveys can be justified economically depends to a considerable degree on their cost, the usability of data obtained and ability to compare data from successive surveys to establish trends. Careful planning, therefore, to secure the maximum of useful data with the least waste effort and over the shortest possible interval of time is of prime importance. Through careful planning of the survey it is to (1) reduce the number of readings, by eliminating duplications and by eliminating those which can be

* Underground engineer.

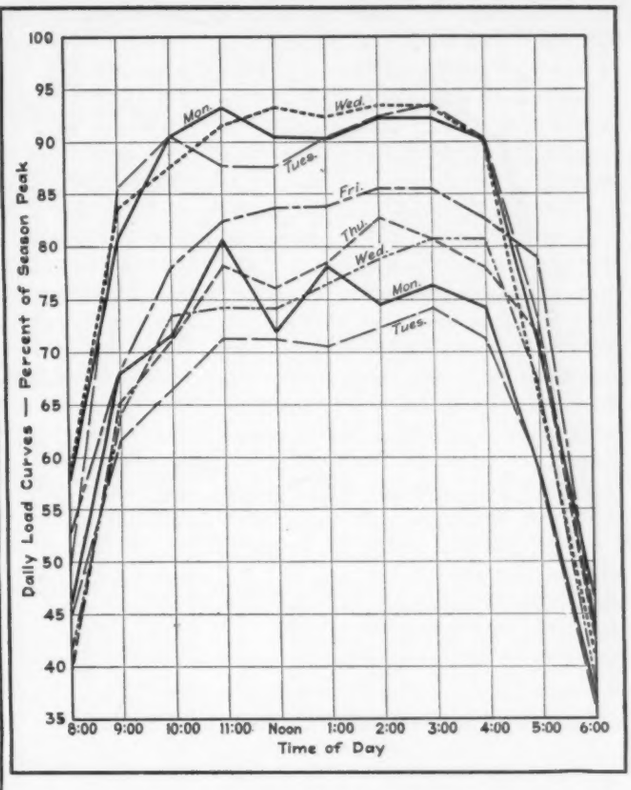


SCHEMATIC MAP of secondary system with each cable section and service numbered is key to survey procedure. Map revised from year to year to show additions to network is used for ensuing load checks

LOAD SURVEY — UNDERGROUND NETWORK SYSTEM

Primary Feeder Off No. 1302 Date 8-20-40 Sheet No. 5

MH No.	Cable Section	Circuit	Designation	Time	Current (or volts) A	B	C	Remarks Corrected to Peak
G20	95	Main	East					
	121	Service	204-6 Main					
	122	Main	West					
	122	Main	East	1:44	22	27	22	38
G25	125	Vault	Woolworth	1:42	43	43	37	60
	126	"	"	1:40	37	37	33	51
	128	"	Midwest	1:45	60	58	58	83
	128	"	"	1:46	62	48	52	86
	132	Main	West	1:48	175	147	137	242
	132	Main	East					
G21	133	Service	214-6 Main					
	134	"	218 Main					
	135	Main	West					
	135	Main	East	1:27	7	16	23	32
	138	Vault	Harvey G2	1:29	130	150	140	210
	139	"	"	1:31	70	73	76	106
47	140	Main	North	1:32	20	15	30	42
	119	"	South					
	120	"	"					
	141	"	West	1:34	285	345	340	484
	142	"	"	1:36	340	340	335	476
	141	Main	East					
	142	"	"					
	622	Service	300-2 Main					
	143	"	"					
G30	145	Vault	Harvey G4	1:54	180	190	205	285
	146	"	"	1:56	150	145	125	208
	147	Service	301 Grand					
	148	"	309-17th					
	149	Main	West	1:58	5	5	6	8
	150	"	"	2:00	5	5	6	8
	149	Main	East					
	150	"	"					
	153	Vault	Kerrs	2:07	185	175	170	255
	154	"	"	2:05	150	135	160	221
G31	155	"	Hudson G3					
	156	"	"					
	157	Service	324 Main					
	158	Main	West	2:10	162	150	115	222
	159	"	"	2:12	173	150	115	238



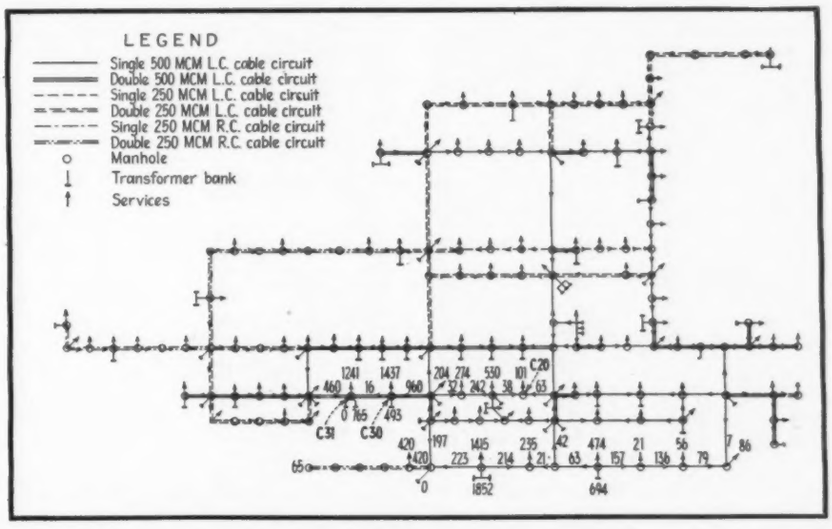
FIELD SHEET shows manhole and cable section numbers corresponding to map. Check marks indicate readings to be taken in field. Readings corrected for time of day and year to give values under peak conditions (left). Underground system daily load curves for survey period (August, 1940) scaled in percent of seasonal peak used to correct field readings to peak conditions (right)

quickly computed by Kirchhoff's network law and those which can be ascertained from existing demand meters. (2) Speed up the survey; readings can be made more nearly simultaneous, simplifying correction to peak condition. Speed-up also contributes to a more economical survey.

In the Oklahoma City network system there are 130 manholes, 62 transformer vaults and 628 secondary cable sections. Load information was required on each cable section. These 628 sections included secondary mains, vault leads and services.

11,000 Values Required

Since information was required on all three phases, a total of 1,884 values for each condition of primary supply was necessary, and with five primary feeders there were five conditions of circuit removal and one with all circuits energized. Therefore, under the six conditions of primary supply, a total of 6 × 1,884, or 11,304, current values were to be obtained; actually, only 5,565 readings were obtained with instruments, the remainder were either known to be zero (vault connections to network when that vault was de-energized) or were computed by means of Kirchhoff's law, or were obtained from existing demand meters. The 5,565 field readings required approximately 312 man-hours of field work.


LEGEND
Single 500 MCM L.C. cable circuit
Double 500 MCM L.C. cable circuit
Single 250 MCM L.C. cable circuit
Double 250 MCM L.C. cable circuit
Single 250 MCM R.C. cable circuit
Double 250 MCM R.C. cable circuit
Manhole
Transformer bank
Services
1241 1437 204 274 550 101 C20
460 16 960 321 242 38 63
0 765 493
C31 C30
420 197 1415 235 42 474 21 56 7 86
420 223 214 21 63 157 136 79
65
0 1852 694

FIELD READINGS corrected to peak conditions and supplemented by computed values and demand meter readings are transferred to simplified network sketch to show division of load

Survey methods used involved three steps, performed in the order indicated:

1. Sheets are made up for recording the field data.

2. Field data are collected by underground test crews.

3. Accumulated data are supplemented by computation and demand charts and studied with a view to applying the proper remedial measures wherever they may be found necessary.

Under the step (1) a schematic map of the secondary system was

made showing every cable section and service with a numerical designation. This map guides the make-up of a set of manhole and vault field survey sheets and is used for checking off readings not required on the data sheets.

Twenty-one field survey sheets similar to that shown are drawn up for recording current values and the time of day at which they were obtained. Every manhole and service hole in the system is listed in the left-hand column of the 21 sheets. To the right of the column, which identifies each manhole, is shown all cable sections entering the manhole with their proper section number and description and blanks for recording load data. In addition to the 21 manhole sheets, six transformer vault sheets are required to list all vault information. These sheets are similar to the manhole sheets.

Field Readings Indicated

Each primary circuit supply condition is treated as a separate survey with a set of 21 manhole and six vault sheets supplied for each. Check marks beside each cable section number indicate those requiring a field reading. Where the same cable section appears in adjacent manholes a reading is necessary in only one of the two manholes. Service load readings are necessary under only one condition of primary supply, since their value is independent of the primary supply. Where several service holes exist between two intersection manholes, with no transformer vaults between, it is necessary to obtain only the service loads and the current from each of the intersection manholes, since the current on the intervening cable sections can be computed from Kirchhoff's law. It is unnecessary to read the current on the vault-to-network leads under circuit conditions where the vault transformer is de-energized, since it was obviously zero when a service did not connect into the vault and was equal to the service load when it did.

Readings are unnecessary on services to buildings where a demand meter is installed.

Three two-man test crews are used to obtain the field data with the 27 sheets divided among the three groups and each crew starting at a different location. The survey is run between the hours of 9 a.m. and 4:30 p.m., since the load curve is flattest over that period. This is important in correcting the values to peak in that the probability of error was lowest.

Three types of instruments are used, with no attempt at correcting readings for sheath currents. Two clip-on ammeters, a Ferranti and a Weston, with 0-500-amp. scales, are used by two of the crews, and the third, assigned to the heavier loaded area, uses a Western Electro Mechanical Company 0-1,000-amp. scale instrument with a separate split core transformer.

Upon completion of each survey the sheets are assembled and returned to the engineering department for analysis. The first step of the analysis is to plot underground system daily load curves on hourly points for each day of the survey.

Seasonal Peak

The season peak, which usually comes in the latter part of August, is obtained and new curves were plotted in percent of season peak by dividing hourly reading by the system season peak. These new curves (shown) represent the loads of the days of the survey as a percentage of the season peak. Each highest phase reading on the field sheets is increased by dividing it by the percent value obtained from the curve for the day and time of day of the reading.

This method of correcting the survey to the season peak has proved sufficiently accurate for all purposes. Values obtained by this method for various cable sections and transformer loadings have been compared to known actual peaks and in all cases have been surprisingly accurate.

Having corrected all readings of the survey to peak condition, they

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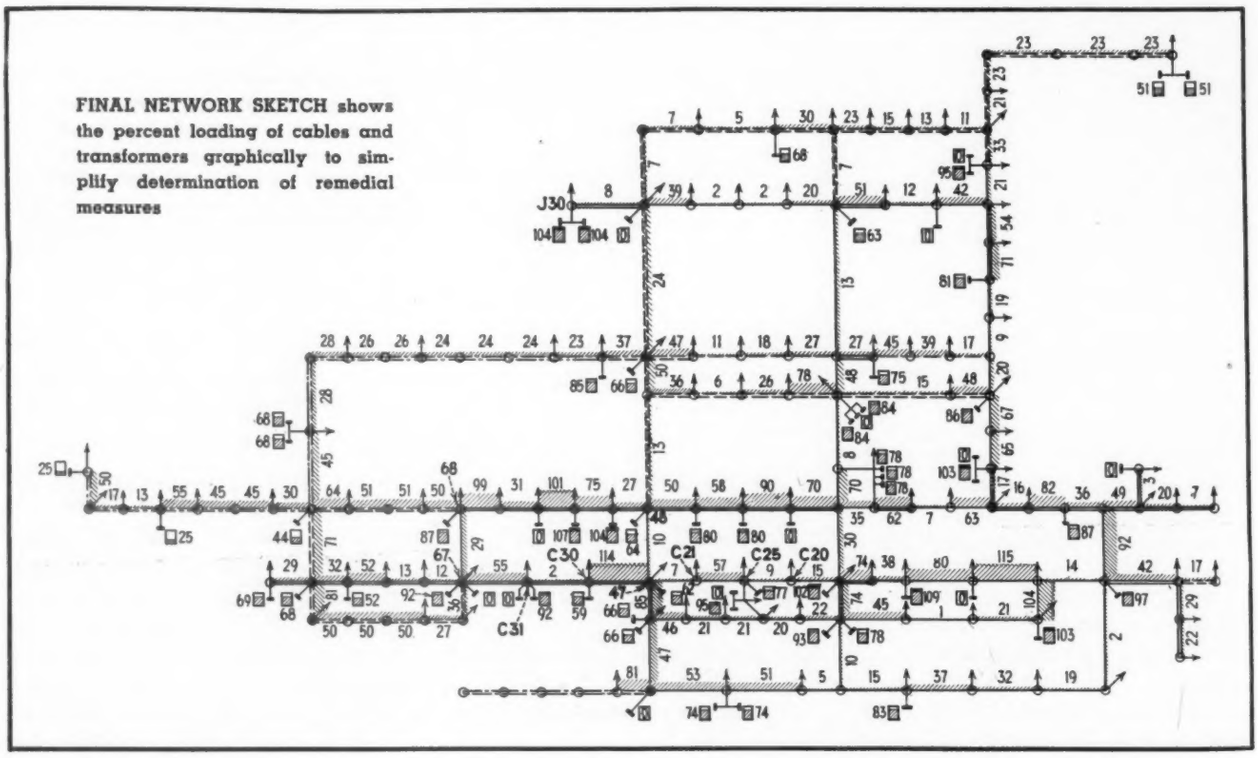
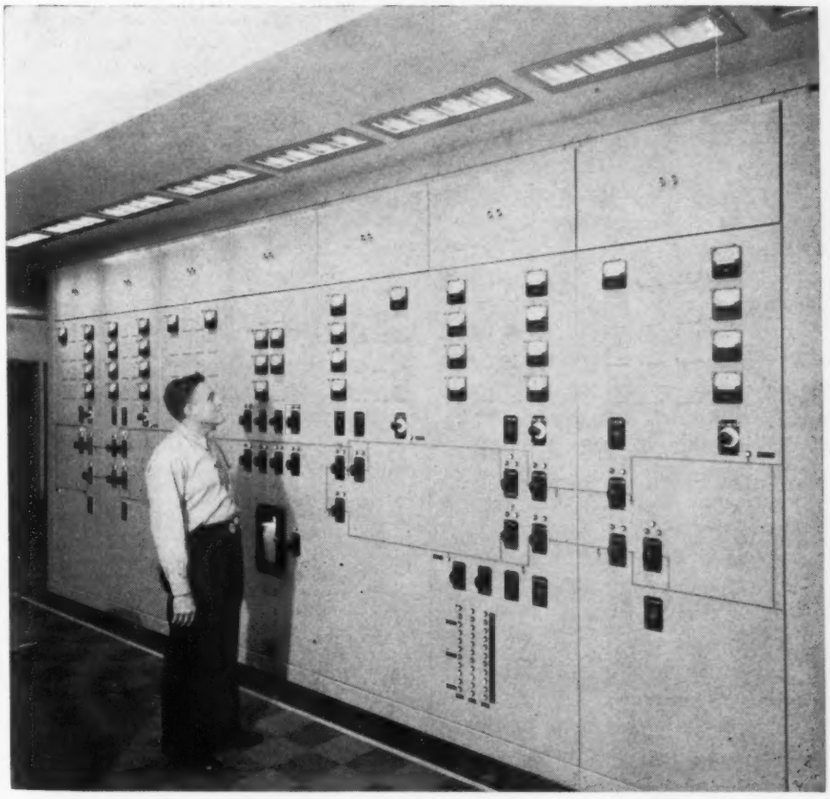


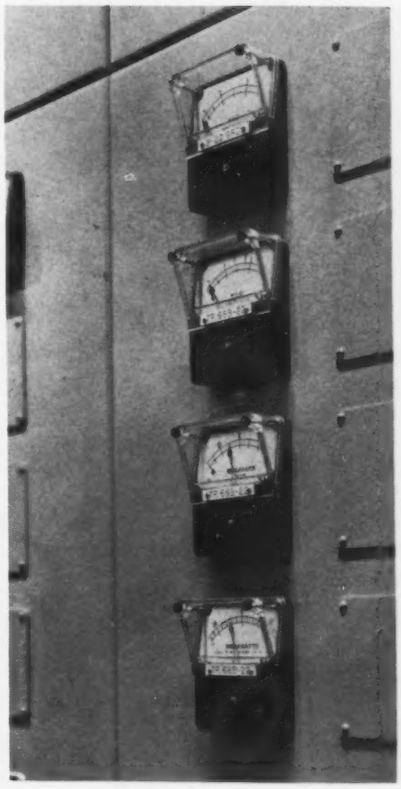
FINAL NETWORK SKETCH shows the percent loading of cables and transformers graphically to simplify determination of remedial measures

Glareless Illumination for Instrument Boards

Direct lighting supplemented by plastic meter cases or reflecting shelves offer solution to veiling glare and shadows on switchboard instruments in generating and substations

EDWARD D. TILLSON, Commonwealth Edison Company, Chicago, Ill.*



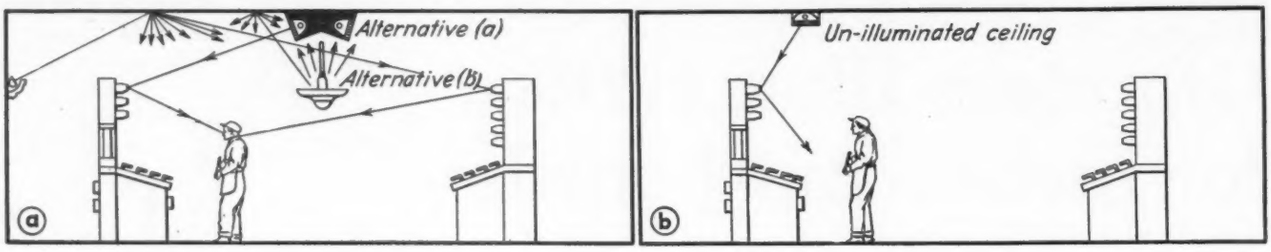


AT THE NEW Fisk station switch-house instruments with transparent covers are lighted from recessed ceiling fixtures with fresnel lens and metallic louvers. At right is a close-up view of transparent instrument covers

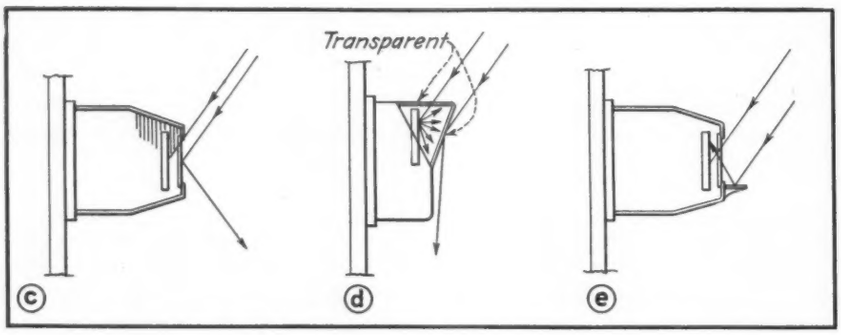
A GREAT MAJORITY of the instrument boards and switchboards in generating and substations employ either flat face or edgewise meters with clear glass fronts which have the natural, but unhappy, faculty of reflecting bright objects such as lighting fixtures, ceiling cove or other illuminated bodies. Resulting images are frequently of such brilliance as to obliterate the instrument scale and pointer entirely. If this object is in front and somewhat above the meters these images will be reflected in the eyes of the operators as they stand or sit in front of the switchboard panels.

Totally indirect fixtures would ostensibly be satisfactory for the purpose, and apparently this is widely believed by designers. However, when galleries, where such lighting is used, are visited it is found that the ceiling glow is sufficiently bright to be very annoying when reflected from the face of the instrument. Also, the area of this glow makes it difficult to maneuver into a position where the ceiling ceases to produce "veiling" glare. The socket husks, stems and hangers which support indirect fixtures also are frequently very bright and are sharply reflected in the instrument faces. Another common fault of switchboard lighting occurs where instruments face windows, skylights, open doorways,

* Testing engineer.



GLARE and reflection in instrument lighting



(a) Incorrect angle of incident light produces bright images of fixtures or ceiling in instrument cover glass.

(b) Correct grazing angle of incident light from louvered direct fixture avoids bright images.

(c) Unless corrective measures are employed even the correct angle of incident light will shade the dial.

(d) Metallic (Alzak) mirror will eliminate shadows when used with correct angle of incident light.

(e) A transparent plastic instrument front is another way to eliminate shadows. Front of the instrument is tilted out to direct reflected rays to the floor out of operator's eyes.

etc., producing large, bright images on the instrument fronts.

From a purely theoretical viewpoint it would be well to have switchboards in rooms where everything was painted black, particularly the ceilings, where no daylight entered, and where the only light for the meters came from a source close to the panels, either from above or below, so that the reflected light pointed strongly downward or upward, thus avoiding the observer's eye. Such an interior, however, would not be livable and would likely tend to drowsiness and a cheerless outlook.

Any lighting of an incidental nature must be carefully executed so that reflections are not borne toward the eyes. Also, the directional lighting of instruments must be of a high level so that it drowns out or overcomes extraneous or incidental light which may be necessary for ordinary working conditions.

Transparent Cases

Granting that light should be directed toward instruments at more or less a grazing angle from either above or below, we are faced with another difficulty, i.e., the overhang of the metal case with respect to the dial and pointer. With grazing angles of light this overhang produces a shadow on the dial, and the stronger the light the more dense the shadow appears, so that an increase in the intensity, which otherwise is desirable, in a large measure defeats itself.

To get around this difficulty, first, the case may be constructed partly of transparent material, such as a thermal plastic or glass, or, second, the case may remain all metal with a reflecting shelf placed below the glazed opening to reflect a portion of the light back through the meter window and neutralize the shadow produced by the case overhang. A narrow shelf with metallic mirror is sufficient for this purpose and is easily applied. Since switchboards are either blown down by air daily or are otherwise carefully maintained, these small mirrors do not suffer from depreciation as they would in ordinary industrial interiors.

Contour of Cases

Commonwealth Edison Company has employed both of the alternatives referred to. For example, in the galleries of Fisk station all of the indicating instruments have been furnished with a case which is partly transparent so that there is no opaque overhanging section above the dial. Also, the front face of the instrument is inclined outward at the top so that light from above, striking this face, is reflected downward at an angle almost parallel to the switchboard. Thus, it is impossible to have the light source reflected into the eyes. The light source itself is an incandescent lamp behind a Holophane fresnel lens which is shielded from the operators' view by metallic louvers. Lamps and lenses are placed in an almost continuous row above and parallel to the switchboard panels. Louvers are painted black so that observers are not conscious of the light source, although it is quite a powerful concentrated sheet of light up and down the room.

Mirrors and Glass Inserts

Thermal plastics are soft and easily scratched. Therefore, at Fisk station that portion of the cover facing the sight-line of the operator is a small piece of plate glass molded into the plastic which surrounds it so that there will always be a full clear view of the dial. In the two galleries some 800 instruments have been thus installed, with very gratifying results.

A low level of illumination from totally indirect sources is provided for the sake of cheerfulness and general activities in the galleries, but this illumination is very low compared with the direct illumination of the meter dials so that the image of the ceiling is not apparent in them.

In the case of edge-on meters having the rounded fronts, the above scheme becomes somewhat complicated and expensive. Therefore, the testing department of the Common-

[*Continued on page 103*]

Chickasaw Plant Solves Unusual Condensing Problems

Sixteen-month erection, one-week break-in — Medium pressure and single boiler justified — Condensing water circulated 3½ miles — Low-headroom condenser has large water boxes

E. C. GASTON, Commonwealth & Southern Corporation, Birmingham, Ala.

LATEST and most efficient steam-generating station of the Alabama Power Company is the 40,000-kw. Chickasaw plant, 5 miles north of Mobile. Although not complete in every detail, the plant was started up in May, 1941, approximately sixteen months after construction began, and was in regular scheduled service less than one week after its initial trial run. During June, the first full month of operation, the plant delivered approximately 29.2 million kw.-hr. (net) to the system, indicating considerable overload capacity. Initial operation indicates that the performance will closely approach the calculated station economy of 12,500 B.t.u. per net kw.-hr. based on 85 percent boiler efficiency, 28-in. vacuum and 5½ percent station service use. Maximum pressure is 850 psi. and total temperature 900 deg. F. at the turbine throttle.

Significant points are (1) the selection of the operating pressure, (2) the choice of a single boiler, (3) the 3½-mile circuit from intake to discharge of condensing water, (4) single-pass condenser with extra large cast-iron water boxes and (5) condensate pumps designed for minimum submergence performance.

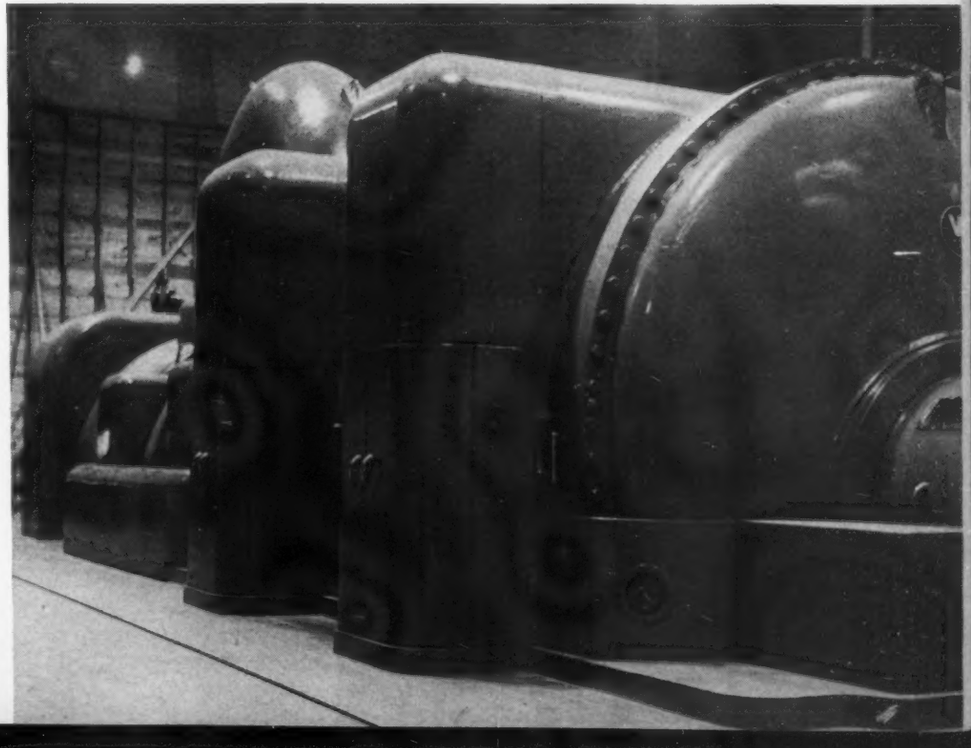
Initial Considerations

Other pressures and temperatures than those selected were considered. Preliminary studies and estimates indicated that the design selected would cost approximately $2 per kilowatt more than a 450-psi., 750 deg. F. plant, whereas the increased economy would be approximately 12 percent in its favor. There were no apparent operating advantages in selecting the lower pressure, since the plant is expected to be operated continuously and at scheduled loads. Design pressures higher than 850 lb. psi. were considered, but were discarded due to the necessity for using a steam pressure in excess of 900 deg. F. or employing a reheat cycle, either of which would considerably increase the cost of the plant and reduce the operating flexibility of the unit.

A single boiler supplies the entire steam requirements of the 40,000-kw. unit. Installation of two boilers was considered, since such a design would obviously increase the flexibility and reliability of the plant. However, preliminary studies and estimates indicated that the two-boiler plant would cost approximately $8.50 per kilowatt more than the single boiler plant. Studies of operating reports on large modern high-pressure boilers indicated that the trend is toward an availability factor almost equal to that of the turbo-generator. It was, therefore, decided to install a single boiler and to make it as reliable a unit as possible by eliminating the causes of forced outages. In specifying the new boiler for this plant maximum stress was placed on the elimination of handholes, gaskets and headers where possible, and on prevention of slagging in the furnace and superheater.

Further preliminary studies dictated the use of a 3,600-r.p.m. tandem-

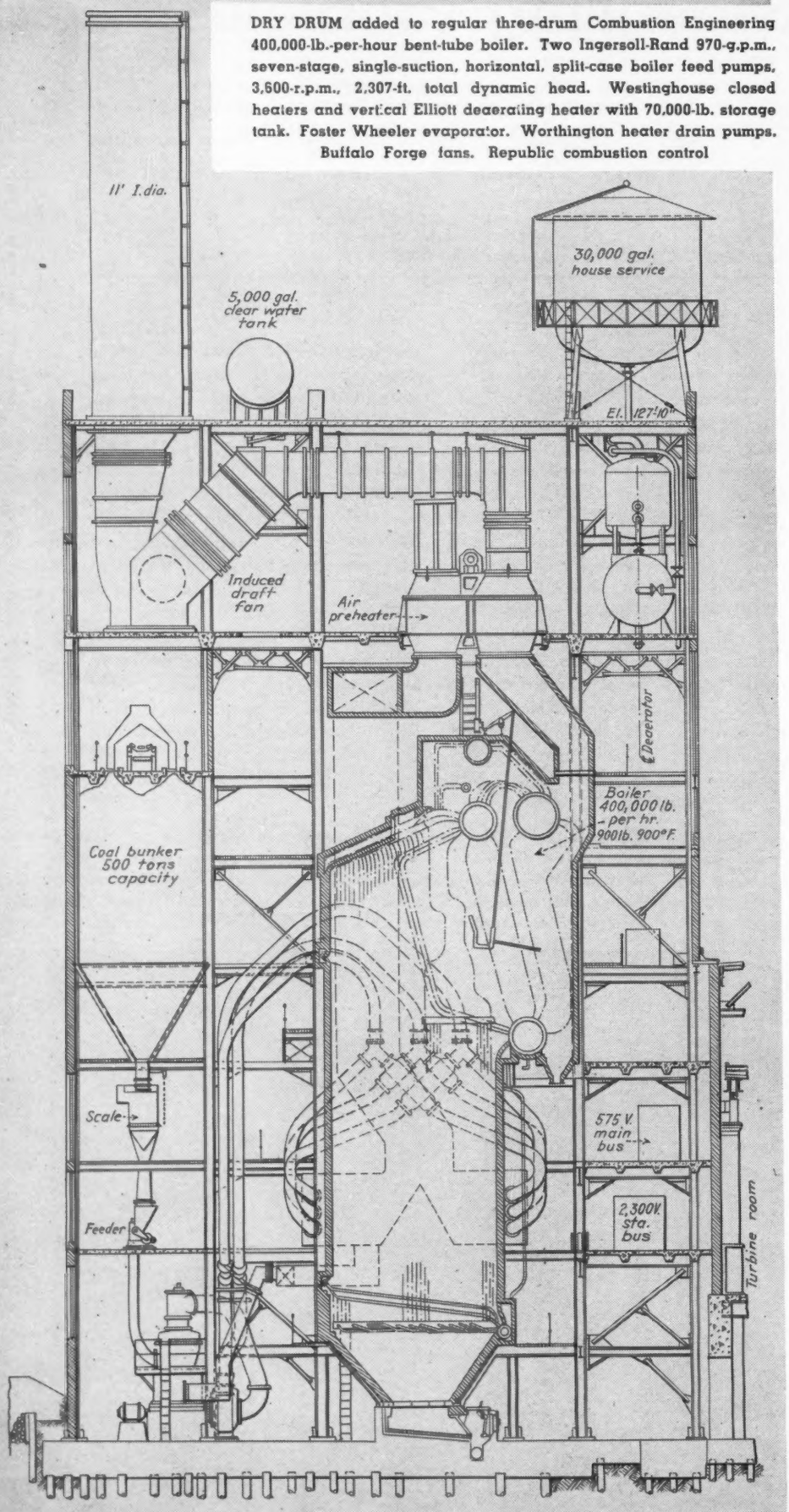
CHICKASAW'S 40,000-kw. unit will serve the phenomenal load growth in the Mobile-Gulf Coast area, supplementing the two 40,000-kw., 110-kv. transmission lines from hydro plants in northern Alabama. The 13.8-kv. generator has a "spring-suspended" stator and is hydrogen-cooled with 135-kv., 250-volt direct-connected main exciter and 3-kw., 250-volt direct-connected pilot exciter. The 4,300-sq.ft. hydrogen cooler requires 450 g.p.m. of 85 deg. F. cooling water. Twin oil coolers require 500 g.p.m.



compound turbine with a hydrogen-cooled generator. The improved economy of the 3,600-r.p.m. unit justified its slight additional cost. Hydrogen and air-cooled units were estimated to cost approximately the same after including the air ducts required with the air-cooled unit, whereas the reduction in generator losses was a decided credit in favor of the hydrogen-cooled unit.

Since hydrogen does not support combustion, it was not considered necessary to provide any fire protective equipment for the generator. A three-phase lightning arrester and capacitor have been installed on the generator bus, close to the machine terminals, for the protection of the stator winding against any voltage surges.

DRY DRUM added to regular three-drum Combustion Engineering 400,000-lb.-per-hour bent-tube boiler. Two Ingersoll-Rand 970-g.p.m., seven-stage, single-suction, horizontal, split-case boiler feed pumps, 3,600-r.p.m., 2,307-ft. total dynamic head. Westinghouse closed heaters and vertical Elliott deaerating heater with 70,000-lb. storage tank. Foster Wheeler evaporator. Worthington heater drain pumps. Buffalo Forge fans. Republic combustion control



Condensing Water Problems

Problems arose in connection with the condensing water system and the use of an existing turbine room and condenser pit (of an idle World War shipbuilding-plant power house) in which it was necessary to install the new 40,000-kw. unit in space which was originally occupied by small 4,000-kw. low-pressure turbo-generators.

Condensing water is obtained from Chickasaw Bogue, a small stream which is adversely affected by tidal movements. Evaporation is not particularly effective in this locality, since the relative humidity is very high during certain seasonal periods. In an effort to secure the maximum recirculating distance and, consequently, the greatest possible cooling pond area, the condensing water tunnels were arranged to permit taking water from Chickasaw Bogue through existing tunnels, provided under the old turbine room, and discharging the water into the head of Hog Bayou through a new discharge tunnel. Hog Bayou is a tributary of Chickasaw Bogue and the arrangement described resulted in a water circuit 3½ miles long from the point of intake to the point of discharge.

Use of the existing turbine room building made it necessary to install the 40,000-kw. unit and its condenser in space which normally would not be considered adequate. Headroom available for the condenser was limited to 18 ft. between condenser pit floor and turbine room floor. To install the condenser in this limited space it was necessary to select an especially designed single-pass (C. H. Wheeler Manufacturing Company) unit with condensate pumps designed for minimum-submergence performance.

The condenser is a 26,800-sq.ft. single-pass, divided water-box unit, designed for maintaining a normal vacuum of 28 in. Hg. The design incorporates extra large cast-iron water boxes (4-ft. 6-in. deep) to reduce the inlet velocity of the cooling water and the resulting turbulence and erosion of tube ends. Admiralty metal tubes $\frac{7}{8}$ in. outside diameter, 26 ft. 3 in. long are rolled into the Muntz metal tube sheets at one end and are packed with Crane metallic packing at the other. The unit is equipped with steam jet air removal equipment, two condensate pumps, each having a capacity of 600 g.p.m., and two circulating water pumps, each having a capacity of 24,600 g.p.m.

Boiler House

The new boiler house is supported on wood piling, capped with concrete, and covered with a 30-in. reinforced concrete slab. Piles were driven to a minimum depth of 30 ft. and the maximum loading was limited to 20 tons per pile.

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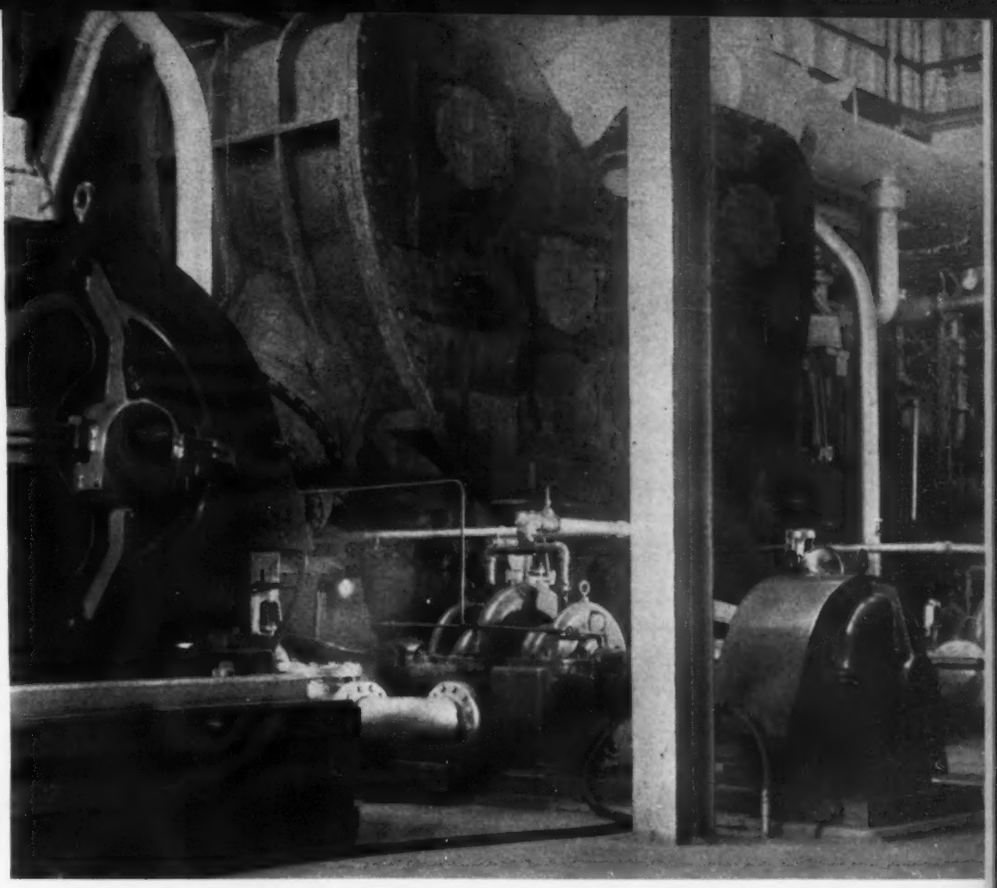
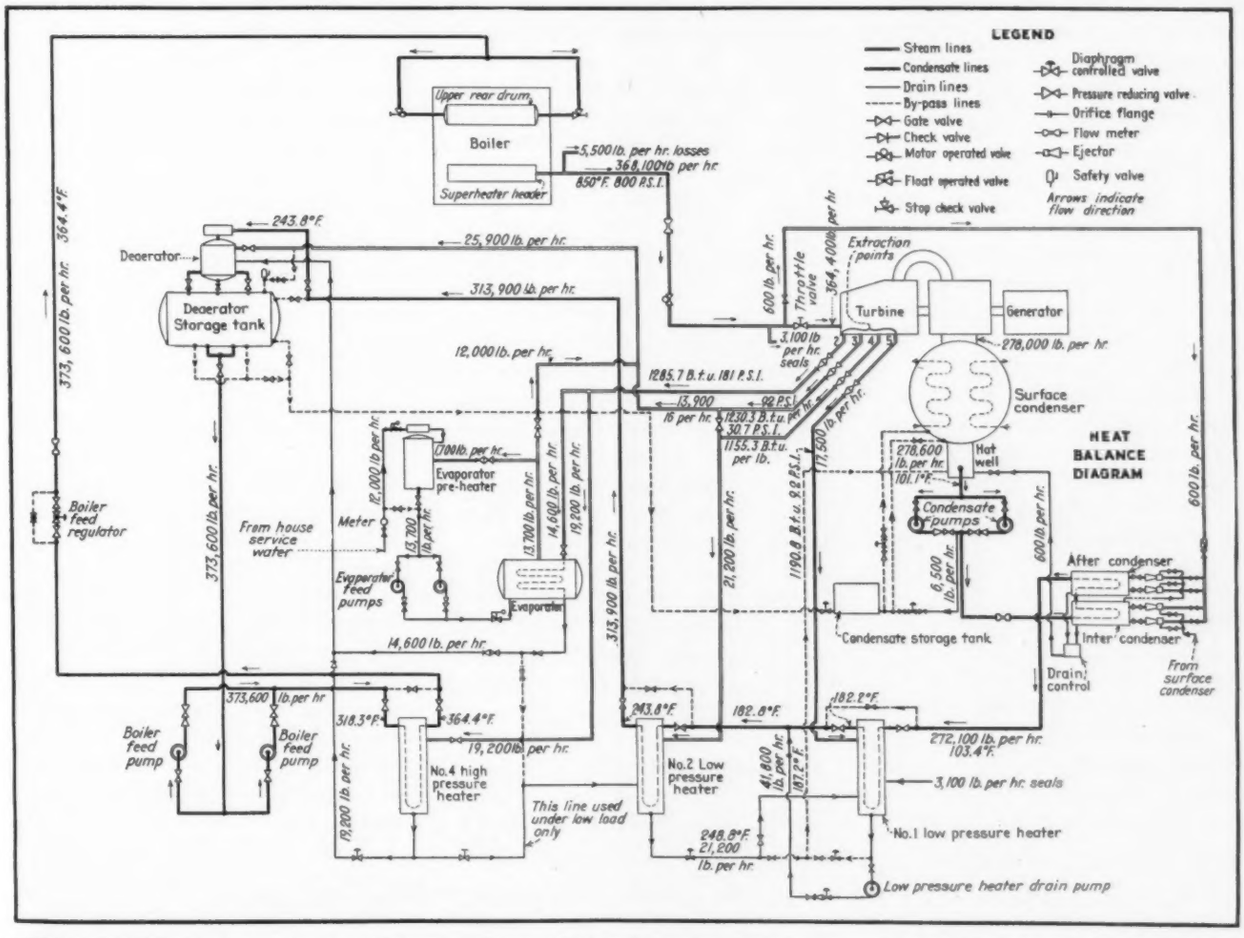


SINGLE-PASS CONDENSER (C. H. Wheeler) designed for 18-ft. headroom with two 600-g.p.m. two-stage condensate pumps designed for minimum-submergence performance



HEAT BALANCE calculations for the Chickasaw 850-psi., 900-deg. F. station show an economy of 12,500 B.t.u. per net kw.-hr., based on 85 percent boiler efficiency, 28-in. Hg. vacuum and 5½ percent station service use

Pick-Up and Resistance of Counterpoise Systems

Analysis of field experience shows radial and continuous patterns efficient for different reasons and different conditions — Deep ground rods a helpful adjunct

W. W. LEWIS, General Electric Company, Schenectady, New York

CURRENT "pick-up" by counterpoise wires (either radial or continuous) and driven rods is found to be substantially in accordance with their resistance values. Apparent resistance is less than the measured value for radial counterpoise and higher for continuous counterpoise. Continuous counterpoises in instances spread their pickup over a 2-mile length. Radial counterpoises (like driven rods) are found to carry considerably more impulse current than has been commonly attributed to them.

Materials and Sizes

The counterpoise, as used in transmission line practice, is a buried wire connected to the transmission line tower. The wire is buried anywhere from 1 to 3 ft. and various materials have been used, such as stranded copper, stranded steel, stranded copperweld, stranded iron, flat steel strip and copper rod. The following sizes have been used: Stranded copper Nos. 1/0 and 2/0, stranded steel and copperweld from $\frac{3}{8}$ to $\frac{5}{8}$ in. diameter, copper rod $\frac{1}{4}$ in. diameter and steel strip $\frac{1}{16} \times 1.5$ to 2 in.

There is insufficient data to say that any of these materials or sizes is better than any other. Length of life and freedom from theft have played a large part in the choice of materials.

Various arrangements of counterpoise have been used, some in which the wire is continuous from tower to tower and others in which the wires are radial at various angles from the tower. Fig. 1 illustrates some typical arrangements of radial or non-continuous counterpoise wires and Fig. 2 typical arrangements of continuous counterpoise wires.

The operation of various counterpoise and driven rod arrangements has been studied by means of magnetic links and the surge crest ammeter.* Data have been secured by the General Electric Company, in cooperation with Pennsylvania Power & Light Company, Appalachian Electric Power Company, Indiana & Michigan Electric Company, Consumers Power Company, EBASCO Services, Inc., and American Gas & Electric Service Corporation. The study has extended over six years on lines of 132, 140 and 220 kv.

In evaluating the efficiency of counterpoise wires and driven rods the following conception is used: The ground is charged under the cloud; when the stroke takes place the charges are converted into current and flow by the lowest resistance path into the stroke. The more current "pick-up" by counterpoise wires and driven rods the lower the resistance of the tower grounding system and the more efficient this system is. The ultimate aim is to hold the tower potential down with respect to ground so that flashover does not take place from tower to conductor, and this object is accomplished by maintaining low resistance.

Radial Counterpoise Wires

Three arrangements of radial counterpoise wires, sometimes called crow-feet, have been investigated.

In one case of the arrangement of Fig. 1(a) with the tower current in the four legs taken at 100 percent, the counterpoise wires brought in 42 percent and the footings by subtraction 58 percent. Assuming the measured tower footing resistance of 47 ohms to be correct, the apparent resistance of the radial counterpoise system is 65 ohms, while the measured resistance of the counterpoise system was 137 ohms. The measured resistance is by megger ground tester or equivalent. In another case the tower current in the four legs was 100 percent, the counterpoise current 49 percent and the footing current 51 percent by subtraction. With a measured footing resistance of 40 ohms, the apparent resistance of the counterpoise system was 41 ohms, as against a measured resistance of 120 ohms.

Sixteen Similar Cases

In sixteen cases of Fig. 1(b) the summation of the tower currents in the four legs was 100 percent, the counterpoise currents 78 percent and the footing currents 22 percent by subtraction. The average measured footing resistance of the twelve towers involved is 129 ohms. Assuming this to be correct, the apparent counterpoise resistance is 36 ohms. The calculated resistance of the counterpoise system from individual measurements was 50 ohms.

In two cases of Fig. 1(c) at the same tower readings were obtained in the four tower legs and counterpoise wires. With the summation of the tower currents taken at 100 percent,

*"Direct Measurement of Surge Currents," C. M. Foust and J. T. Henderson, "Electrical Engineering," April, 1935, pages 373-378.

the counterpoise wires brought in 70 percent and the footings by subtraction 30 percent. Assuming the measured footing resistance of 91 ohms to be correct, the apparent resistance of the counterpoise system is 39 ohms. The counterpoise resistance was not measured. In another case, with the tower current in the four legs assumed to be 100 percent, the counterpoise wires picked up 84 percent and the footings 16 percent by subtraction. The footing resistance measured 95 ohms, which gave an apparent resistance for the counterpoise system of 18 ohms. The counterpoise resistance was not measured.

From the examples given, it will be seen that the radial counterpoise systems are very efficient and carry considerably more current than indicated by their measured resistance. The apparent resistance is approximately 35 to 70 percent of the measured resistance. Data have been published showing that the impulse resistance of driven rods is from 30 to 90 percent of the measured megger resistance, depending upon the current magnitude and wave shape.

Continuous Counterpoise

The performance of the continuous counterpoise is evaluated for a given stroke by determining the current picked up by the counterpoise between towers. This is done by comparing the current leaving a tower with the current arriving at the next tower. The summation of these currents subtracted from the summation of the tower currents gives the footing pick-up.

Of the many cases available, two will be discussed. The arrangement in both cases is that of Fig. 2(c). In the first case the line is equipped with two overhead ground wires and a continuous counterpoise. Ten towers were involved in the stroke. The current distribution was as follows: Tower current 100 percent, counterpoise pick-up 84 percent and footing pick-up by subtraction 16 percent. The measured footing resistance varied from 50 to 148 ohms, with an average of 92 ohms. The resistance of the ten tower footings in multiple is 9.2 ohms. From the current distribution the apparent resistance of the counterpoise system is about 1.75 ohms. The average measured resistance of the counterpoise by megger tester was 1.3 ohms.

In the second case the line is equipped with counterpoise, but has no overhead ground wires. Four spans of counterpoise were involved, but only one tower carried current. Following was the current distribution: Tower current 100 percent, counterpoise pick-up 87 percent, footing pick-up by subtraction 13 per-

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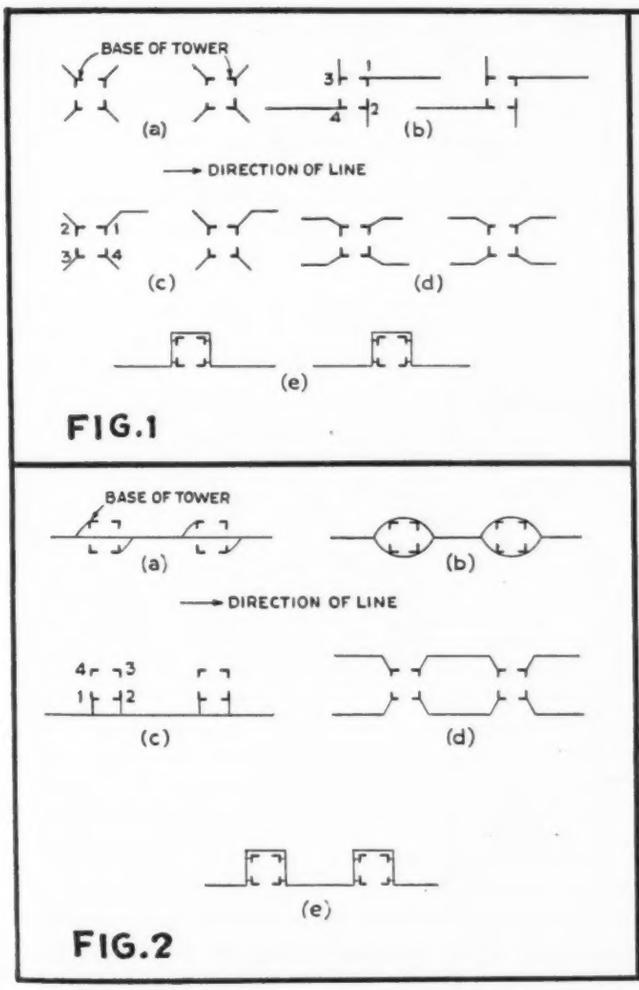
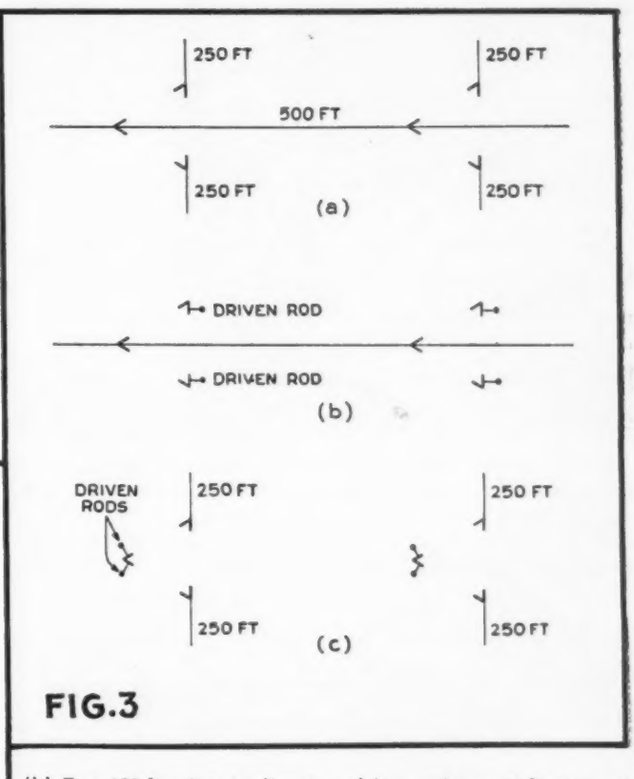


FIG. 1—Typical arrangements of radial (non-continuous) counterpoise wires

(a) Four 50-ft. wires at 45 deg. from the direction of line.



(b) Two 150-ft. wires in direction of line and two 40-ft. wires at right angles.

(c) Four 50-ft. radial wires with one extended 200-ft. in the direction of the line.

(d) All four tower-leg radials extended parallel to line.

(e) Non-continuous wire encircles tower with connections to all.

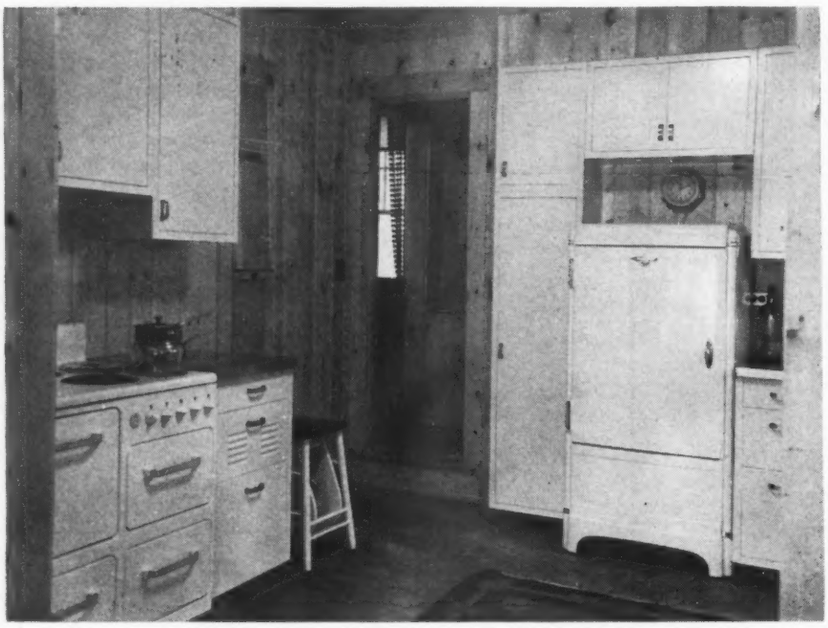
FIG. 2—Typical arrangements of tower-to-tower counterpoise wires

FIG. 3—Experimental installations of tower-to-tower and right-angle counterpoise wires and driven rods

Kitchen Planning Service as Good-Will Builder

Connecticut Light & Power averaged 5 kw. of residential load per kitchen plan —Three districts attain usage of 1,945 kw.-hr. per customer per year — Appliance service by company reduces load mortality

HENRY C. JOHNSON, Connecticut Light & Power Company, South Norwalk, Conn.*



MODERN electric kitchen built into a converted garage (note cement floor). This design employs ventilation space around refrigerator, left hinge door for customer convenience. Westinghouse range burners are remote from side wall, and counter adds safety feature by protecting pot and pan handles from traffic flow. Cabinet height above burners avoids steam pocket

THAT kitchen planning, properly handled, is a worth-while load builder has been proved by the experience of the Connecticut Light & Power Company, where in the Norwalk, New Milford and Greenwich districts, located in southwestern Connecticut, more than 200 kitchen plans and layouts were designed and submitted to customers during the past year.

This service was rendered without charge to customers and in addition to creating much good will resulted in an increase of more than 1,000 kw. in the company's residential load.

*Kitchen consultant.

Merchandise sales by company salesmen and by cooperating dealers of electrical appliances increased considerably as a result of this service. A favorable reaction for our company and its program also was received from local merchants of non-electrical kitchen equipment who shared in the development of the modern kitchen promotion. Such dealers included those selling cabinets, floor covering, paint and utensils.

That the residential load is important to any utility company is obvious. It accounted for 31.9 percent of our total company revenue. The greatest profitable load-building opportunities in the home are in the kitchen. In the modern kitchen today are the electric range, refrigerator and sink attached to the electric automatic water heater, the disposal, dishwasher and various smaller electric appliances. Here are some of the reasons why in Norwalk, Greenwich and New Milford in the past year the average annual usage per customer was 1,945 kw.-hr. for 25,245 residential customers.

More than 150 old homes and 50 new homes, covering a total area of 250 square miles, were "surveyed" by the company in the three districts mentioned. This survey was made in cooperation with architects, home builders and building contractors. Out of two hundred kitchens surveyed, 15 percent were already users of electric ranges and refrigerators, but to the balance 102 ranges, 21 water heaters and 75 refrigerators, six dishwashers and nine miscellaneous laundry appliances, or a total of 213 major units were sold. Within 30 days after the plans had been submitted and approved the installations were executed in full or in part. This figure does not take into consideration sales made by cooperating dealers and other outlets, or additional sales made by our own sales department without the aid of the planning service.

How It Works

We have fourteen domestic retail salesmen with assigned territories in the three districts who turn in requests for assistance in kitchen planning. This assistance is particularly stressed during the first call. A tentative ap-

RED CROSS Princess coal stove and 40-watt lighting load make way for electric refrigerator and, across room, electric range, ventilating fan, high-wattage kitchen lighting unit (not shown) and basement automatic water heater

pointment is made by the salesman for an interview and survey of the kitchen. After the necessary data have been obtained, covering dimensions, etc., a layout is prepared to scale on a cross-section sheet. From this information a complete kitchen is then prepared in miniature, including appliances, storage facilities, walls, doors and windows.

However, it has been found, to our advantage, that the customer reacts more favorably if she actually plans her kitchen herself with the miniature units. Alternate suggestions are offered at the time and finally, when approved, notation is made on the chart of the equipment arrangement, storage and other facilities. Detailed plans are then prepared and submitted to the customer.

During the preliminary set-up of the miniature units a complete explanation is given of the proper size and design of equipment and the amount of space required around the electric appliances for proper ventilation which will result in efficient and economical operation and ease in cleaning. We point out the advantage of locating range and counter or cabinet next to sink as a unit rather than refrigerator counter and sink, if one of the two major appliances has to be separated from sink due to doors or windows. Lighting, ventilation and heating requirements are also covered, as well as adequate wiring and installation of convenient outlets.

This complete story, as outlined in miniature, leaves a definite picture and creates interest in the customer's mind until the sketches have been submitted. When this is done the salesman then completes his transaction in closing the sale of appliances as indicated in the sketch. With delivery of the equipment, the home service representative of the company calls and assists the housewife or servants in the efficient and economical operation of the appliances.

Let us not forget the existing customer who helped to pioneer the all-electric kitchen idea and who long ago purchased the best equipment available. At that time little, if any, thought was given to its proper location from the standpoint of economy and convenience. In other words, we must diligently work to hold onto present loads as well as add new loads.

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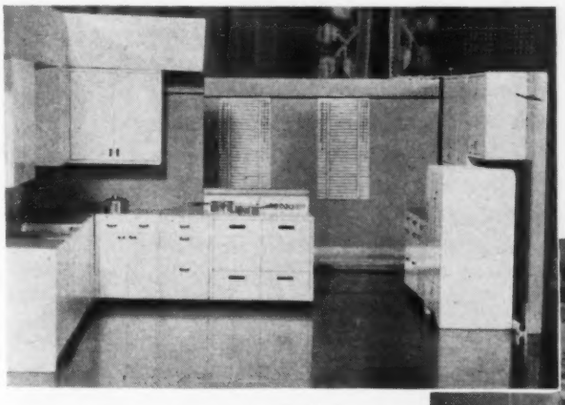


PROTOTYPE and model —Utility company sets up models so customer can see the kitchen she is specifying. Large picture is the kitchen as actually developed from model

Editorials

S. B. WILLIAMS, *Editor*

Not Too Busy to Make Another Friend

THERE CAME to our notice recently the experience of a family that moved residence into a different utility service territory. New service had to be arranged for with the electric light company and with the telephone company.

In the next few days there came several mailing pieces telling about the telephone service and explaining its facilities and also a pleasant voice over the wire asking if everything was all right and hoping that life in the new home would be pleasant.

Nothing more was heard from the electric company until the bill came at the end of the month. What a difference!

The company, which is part of a utility system bigger than any light and power organization, a system that has successfully withstood government attack, a system that already has a lot of friends, was not too much engrossed with its own affairs to make another friend.

Something for Nothing

SOME very interesting figures on the cost of improved street lighting were presented at the recent I.E.S. convention by L. J. Shrenk, head of this work in the pioneer city in safety highway lighting. He points out that in ten years Detroit has increased its street lighting from 28,000 lamps with an average light output of 4,300 lumens per lamp to 40,000 lamps with an average of approximately 7,000 lumens per lamp, at an increase of but 11 cents per capita, or from 91 cents to $1.02 per capita for all costs of operation, maintenance, depreciation and interest. The average expenditure for the country, according to the 1940 Ortleib statistics, is 96 cents per capita.

This is not the final figure for Detroit because there is still more than 45 percent of the rehabilitation to be done. When that is completed it is estimated that the cost will not exceed $1.35 per capita.

This seems like a very small cost for such a tremendous improvement in the safety of the city, but these figures do not show the true economy of the Detroit program.

It has been stated and the figures when available show that properly designed street lighting cuts down night-driving accidents from 20 to 50 percent. These accidents cost the taxpayers considerable. Hartford, for instance, estimated $3,000 per mile for excess night accidents.

A proper accounting would credit improved street-lighting costs with this saving, and then, instead of costing slightly more, modern street lighting for all costs, including depreciation, would cost the taxpayers less than outmoded, inadequate lighting.

It's seldom that one can get something for nothing in this world, and this appears to be one of those rare instances.

The Prospects of Power Rationing Caused by Turbine Deferment

IN THE difference of opinion which has now come out in the open between FPC and OPM with respect to deferment of land turbine deliveries in order to provide more manufacturing space for Navy turbines the utilities are in the position of being innocent bystanders. And, as so often happens, the bystander is the one to get hurt. If the defense demand grows anything like Chairman Olds predicts, then in many localities serious power rationing will have to be imposed. This will mean not only loss in revenue but additional cost to police a situation of some one else's making. In spite of this, however, the same kind of cooperation which Mr. Olds has publicly acknowledged will be given by the utilities.

In the meantime one might speculate on just how serious a threat to the power supply of the country this turbine deferment program would be. In an address last week before the Baltimore and Washington A.I.E.E. members Mr. Olds predicted the probable effect of freezing the utility capacity at the end of 1941. According to his assumption of defense requirements, the necessary reductions in non-defense loads would be great, ranging in some areas in 1943 to as high as 55 percent.

There is nothing to indicate at the moment that capacity will be frozen at the 1941 figure. So far between 30 and 40 turbines have been delayed from one month to a year because of the new Navy schedules. While this represents a substantial part of the manufacturing space that had been set apart for large utility turbines, we would estimate that it still leaves a million or more kilowatts of non-deferred production for "must" situations.

It is difficult for us to believe that the Navy would jeopardize the defense effort to the extent of depriving utilities of all additional generating capacity, or that OPM, which must know the advance defense requirements, would make needless trouble for itself. We have to believe, then, that a substantial volume of new turbine

capacity will continue to be delivered to the utilities.

There is another side to this situation, however, that must be considered in appraising the future power supply. Through the second week in November there has been an increase in output of less than 10 percent over the 1940 weekly high. In other words, there is a seasonal condition still reflected in the weekly output figures and even more pronounced in the comparative non-coincident peak figures. For that reason it must be obvious that if non-defense rationing were necessary it would not be on a kilowatt-hour basis but on a kilowatt basis, and then only during the period of peak.

While inconvenience might be caused non-defense manufacturing, there is no reason why that production could not be spread more over off-peak hours, especially as it probably would be required only during a brief period in the year. With everybody inconvenienced in some measure by the war, this does not seem like too much to ask.

We have never agreed with the Federal Power Commission on the proximity or severity of predicted power shortages, but we feel that the commission is rendering a service to the public and to the industry, and now to the defense administration, in promptly making available its statistical studies on peaks, capacity and reserve. No matter what one's opinion may be or how one estimates, the trend cannot be denied. If the figures in another six to nine months substantiate the pessimistic predictions of Mr. Olds, then some higher authority than either FPC or OPM will have to decide how far the non-defense economy must be curtailed in favor of the Navy.

Incentive for Better Safety Performance

UNSAFE ACTS of employees were factors in 95 percent of a large group of fatalities and serious injuries on which detailed reports were available for analysis. The accidents which occurred in 1939 and were analyzed by National Safety Council indicate two principal causes of employee failure to act safely. First is improper attitude (disobedience, recklessness, etc.) 61 percent, and lack of knowledge or skill 30 percent.

The latter cause has probably grown worse due to changes in employment and difficulty in getting competent labor. However, it is a situation that can be covered by more intensive training.

Disobedience, carelessness and such infractions of the rules are much more difficult to overcome. The very best linemen will have lapses and show a disregard for safety measures, and no amount of training will completely break them of these slips from grace. These men, however, are not only a hazard to themselves but to other employees as well, in addition to being a large expense to the company in high insurance rates.

Companies have a habit of leaning over backward in punishment, but in the long run this is no kindness to the employees. If a punishment could be coupled with an incentive much of this carelessness might disappear. The company might share, for instance, with linemen on the basis of individual performance a part of the insurance savings. We greatly suspect that with this type of workmen appeal to reason will not be as effective as promise of reward.

Reactive Undergoing Clarification

POWER-FACTOR DEFINITIONS exist, but they are not unanimously accepted as being rigorously true because they hinge on doubts about reactive component under all possible combinations of load and voltage unbalance, harmonics, etc. Nevertheless, reactive metering goes along blissfully, ignoring these missing academic refinements. However, even reactive metering itself has been befogged by the confusion that is certain to happen as long as reactive, with plus and minus aspects, also is treated as if it had two-way flow possibilities.

One significant forward step was made when a reactive volt ampere was dubbed a var after Dr. A. E. Kennelly's urging. That did not help, however, to dispel the fog occasioned by contemplation of the relative meaning of "vars lagging in" and "vars leading out." J. Allen Johnson in the A.I.E.E. in 1933 insisted there was only one quantity—magnetizing reactive power—and that it could have only an in or out direction.

Now this is being recognized and being acted upon in the labeling of instrument scales. But meanwhile the down-scale swing of a varmeter accompanying an upscale swing of a wattmeter is disconcerting to the best of switchboard operators. Confusion is doubly confounded when both meters are on a tie line with reverses of power flow and power factor.

A new simple "in" and "out" marking of varmeter scales promises to make this all as simple as the same terms on a pair of restaurant doors. The grocer brings food in one door and the waitresses pass through the other to serve it. Hunger does not travel through either door. Electrically the food analogy is the excitation of magnetic configurations. If a capacitor or synchronous condenser helps a generator to supply it, it is still magnetizing vars headed for the magnetically hungry induction motors, furnaces and whatnot. A downscale (left) deflection of a varmeter will mean to the operator an underexcited condition of the machine or machines in the station or plant. If it is a synchronous generator, condenser or motor he can correct the situation by providing more excitation, *i.e.*, more magnetizing vars.

By thus dropping the terms lead and lag for other than purely power factor designations the intricate problem of varhour metering on tie lines can (if the lawyers stay out) be accomplished with two varhourmeters. These situations have frequently required four varhourmeters switched in pairs by means of a polyphase power directional relay whenever the power flow reversed.

Washington Comment

By GEORGE E. DOYING, Jr., Washington Correspondent

Public Power Trust Out to Get Krug

THE New Deal public power trust is out to get J. A. Krug, OPM's power chief. And they'd like to hang Donald M. Nelson's scalp to their belts, too.

Rural Electrification Administration is leading the pack. Its spokesmen make no bones about their attitude. Nor is the agency making much effort to conceal its forays against the OPM power consultant.

The government power cult in Congress is taking the vocal initiative, using the Congressional Record as a soap box for spreading bitter attacks upon Krug and his staff. "Saboteurs" and "Trojan Horse" are terms applied by Rep. Clyde T. Ellis, whose chief objective is to nurture a duplicate of the Tennessee Valley Authority in the Arkansas Valley regions.

FPC Opposition

FPC hasn't broken openly with Krug, but Chairman Leland Olds, in a recent speech to which FPC gave wide publicity, bluntly voiced opposition to the prevailing policies at OPM in regard to programming additional generating capacity. And FPC doesn't like not being invited to participate in the Southeastern power curtailment operations.

Secretary Ickes, who still wants to be power czar himself, isn't taking any visible part in the proceedings at this stage, but he and his power staff aren't happy about the OPM set-up. It's true that Krug has smiled upon rapid development of Grand Coulee as a source of large quantities of energy quickly, but it is also true that Krug has slammed the door on others among Ickes' favorite schemes because they were considered to espouse the cause of public power more than the war effort.

As can be seen, the attack upon OPM and Krug isn't consolidated. Really, it's three attacks, because there is no love lost among REA's Slattery, FPC's Olds and Interior's Ickes. But a common motive at the moment is the same—to get their way on matters pertaining to power and to preserve, each for his own agency, the vested interest which is theirs as an old-line agency in the governmental framework. What all three are finding out is that the necessities of war which dictate a 50 percent slash in production of civilian materials cuts also into expensive promotional campaigns to expand public power and other peacetime luxuries of government reform.

REA's attack is the most rabid and the most bitter. Three months ago REA piously told all and sundry it was prepared to accept the inevitable sacrifices for defense, to curtail its line-building activities in order to conserve copper and other scarce materials. Now, REA officials are open in their accusation that "Krug has sold out to the private utilities."

REA Charges

They base their charge upon the contention that, while they have got no allotment of copper since August, private utilities still get "all they want."

They contend private utilities are building "spite lines," and telling rural customers "REA is washed up, but we'll get copper and build lines to you."

They insist that Krug's staff consists of private utility men who refuse to give REA priority ratings on their projects. As a matter of fact, there was only one man on Krug's staff to administer the Southeastern power curtailment whose career has been wholly in the private utility field; a fact also that the top man of the priorities staff has a background which is predominantly non-private utility.

Congressmen Ellis and John Rankin of Mississippi and Senator Clark of Idaho have taken up REA's chants, echoing them in the appendix of the Congressional Record.

Secret Hearings

Last week the House appropriations subcommittee which handles REA's budget staged a secret hearing to listen to Slattery's complaints and to Krug's reply. The affair didn't turn out too well for the arrangers. Committee members wanted Slattery to identify the "spite lines" being built by private utilities. He didn't have specific examples. They asked for names of the utility men who have discriminated against REA priority applications. He didn't have these, either.

Congressman Everett M. Dirksen of Illinois, no friend of public power, told Slattery that Krug had been coming before the appropriations committee for several years in behalf of TVA and had pleaded the cause of public power most eloquently.

Olds' "break" with Krug hasn't taken the violent turn that REA's has, and probably will not. The FPC chairman, keeping a velvet glove on his hand, is avoiding personalities, but makes no bones about his disagreement with OPM's approach to the power problems of the war. Olds is campaigning for a maximum expansion of the nation's generating capacity in order to permit absorption of the munitions power requirements while maintaining normal load growth. He feels that the nation must build for the future even while it is fighting Hitler.

FPC Disagrees

OPM doesn't see the problem in that light. In the power field this boils down to a policy of letting the Navy take every foot of turbine building space it can utilize in speeding construction of warships, even though the cost in needed production for utilities is high. Olds decries the theory that defense power requirements can be met by curtailing normal use of electricity where extra capacity is thus delayed.

This feud for the seat at the right

[*Continued on page 105*]

NEWS OF THE WEEK

OPM Issues Amendments to Priorities Order P-46

Minor plant additions, underground connections, inventories and use of materials and supplies and meters covered by new regulations — Interpretive bulletin available

The long-awaited interpretations and amendments to Priorities Order P-46, which gives an A-10 rating to maintenance and operating materials for utilities, were issued by OPM this week. Changes made by the amendment give a dollar definition to the minor capital improvements for which materials may be obtained through the A-10 rating and revise the entire Section F setting up limitations on inventory and use of materials.

Eliminated entirely from the order is the phrase permitting connection of new consumers only to the lowest pressure system, a clause which has caused considerable confusion throughout the industry. The new Section A(6)(ii) prohibiting use of the rating for additions and betterments of property uses this wording to cover improvements which are permissible:

New Consumers

". . . the connection of new consumers, and minor improvements needed for relief from serious overload and other minor capital additions: Provided, that such connection of new consumers, minor improvements and other minor capital additions shall not include any work order or job in which the cost of material shall exceed $1,500 in the case of underground connections, and $500 in the case of other capital additions, and provided, further, that no single job shall be subdivided into parts in order to come below these limits."

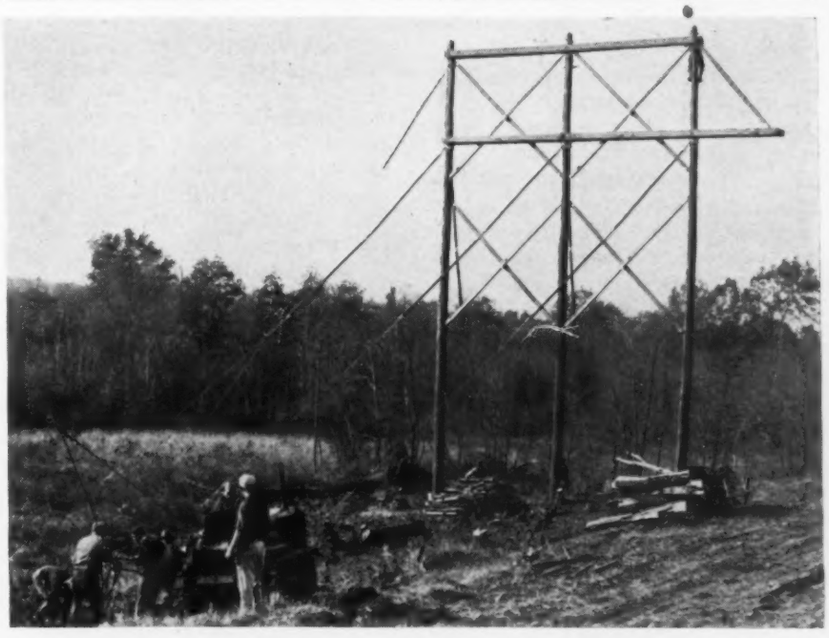
Revision of Section F involves a complete rewriting of the provisions permitting relaxation of the strict requirements this part of the order sets up. Limitation of inventory and use of repair and operating materials to the 1940 dollar volume is retained, except where special permission is obtained from OPM's Power Branch.

Inventories and use of materials may be increased over the 1940 dollar volume in any quarterly period "proportionately to the increase in system output in the preceding calendar quarterly period over the system output in the calendar quarter of 1940 corresponding to such preceding calendar quarterly period." In other words, if system output in the July-September quarter was 15 percent greater than in those months last year, dollar value of inventories and use of materials in the October-December quarter may be increased 15 percent over the actual inventory and use of materials in the last quarter of 1940.

Meter Purchases

A new section relating to meters is included. Utilities may purchase and use, in any quarterly period, not in excess of 25 percent of all meters condemned or destroyed in 1940 plus the number of meters necessary to serve the net increase in customers.

Another new section makes provi-



BOSTON GOES TO H-FRAME—Erecting Boston Edison's new 10.5-mile, 110-kv. line at an angle frame in the run between Medway and Framingham, with aid of a 7.5-ton International Harvester tractor anchoring a No. 4/0 copper power conductor. This is the company's first use of H-frame construction, 147 wooden frames being required. The new line will strengthen power facilities in the important residential and industrial area at the west of Boston proper, where much vital defense work is under way

sions for up to 2 percent excess use of materials in any quarter to meet "unavoidable or emergency situations." A third new section permits unlimited use of materials for maintenance or repair required because of fire, flood or other climatic conditions.

A final section makes clear that the Section F limitations do not apply to such operating supplies as fuel, water purification chemicals, wooden poles or wooden crossarms.

In addition to the amendments to the order, the Power Branch has prepared a Question and Answer Bulletin on the original P-46 order. This may be had by writing for Release PM T-50.

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Power Cut Postponed in Southeast Area

Rain, increased pooling and curtailed load reduced the amount of drawdown from Southeastern hydro reservoirs from 82,500,000 kw.-hr. to 31,000,000 kw.-hr. weekly in a month's time, OPM Power Coordinator J. A. Krug disclosed this week in announcing indefinite postponement of a proposed 30 percent cut in commercial and industrial power consumption in the area.

Mandatory pooling of generating facilities and the blackout of sign, ornamental and decorative lighting remain in effect throughout Alabama, Tennessee, Georgia, the Carolinas and parts of Mississippi and Florida; "freezing" of large consumer use to September levels remains in all except the major portion of the Carolinas. Mr. Krug said, however, he hopes that the blackout provisions can be modified by December 15 or earlier, in time to permit traditional Christmas displays.

Mr. Krug released the following table showing how OPM's power conservation program, aided by some rain, has improved the power situation in the drought area:

	Week Ended	
	Oct. 25	Nov. 22
	(In Millions of Kw.-Hr.)	
Weekly load	246	234.5
Stream generation	35	60.1
Fuel generation	100.8	102.9
Pooling receipts	27.8	40.5
Storage drawdown	82.5	31.0

All of the increased stream generation resulted from rains; the area had one general rain, November 5-6, which created about 70,000,000 kw.-hr., and another last week centering in Tennessee, which produced another 112,000,000 kw.-hr. Mr. Krug added that utility engineers in the area estimated that uncurtailed load for the week of November 22 would have been about 252,000,000 kw.-hr., which means that savings totaled 17,500,000 kw.-hr.

Frank D. Comerford Dies in Boston

Frank D. Comerford, 48, president of the Boston Edison Co. since 1935, former president and chairman of the New England Power Association, Boston, died at the New England Baptist Hospital in that city late Monday evening, November 24, after an illness of several weeks. An outstanding exponent of co-operation with governmental regulating bodies and a lawyer with unusually acute comprehension of utility administrative problems, Mr. Comerford exerted a constructive influence far beyond the confines of the properties under his direction.

Born at Worcester, Mass., and educated at Holy Cross College and Harvard Law School, he was admitted to the bar in 1917. Eight years later he was promoted to a partnership in Ropes, Gray, Boyden & Perkins, Boston, and during the World War he was counsel to the Fuel Administrator for New England. In the Ropes, Gray offices he laid the legal groundwork for some of the larger organization and financing projects of the early 1920's, including the New England Power Association, which was organized in 1926. In 1927, at the age of 34, Mr. Comerford became president of the association.

Under his administration the association developed broadly as to plant expansion, service growth and public relations. The 15-mile Falls project on the Upper Connecticut, since named the Frank D. Comerford station, was built, and much other important system progress achieved. He became chairman of the NEPA board, serving until June, 1941.

In 1935 Mr. Comerford was elected president of the Boston Edison Co. and in his leadership demonstrated a genius for timing in financial affairs which was of great benefit in the attainment of low interest rates on bonds issued. Major system improvements were inaugurated and the resources of the company dedicated to the defense program without stint, including far-reaching plant expansion and co-ordination of personnel and facilities for maximum public service.

Chairman Carroll L. Meins, Massachusetts Commission, said: "The untimely passing of Frank D. Comerford has removed from our midst one of the outstanding executives of New England. His associations with the department revealed him to have been a clear-thinking, energetic and progressive administrator, but one who found time, nevertheless, during his very active business career to serve and co-operate with many civic interests of New England for the past decade. He will be greatly missed by all those whose good fortune it was to know him."

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Ask Price Stabilization on Small Appliances

Manufacturers of a wide range of small household appliances were asked to keep prices at November 1 levels in letters sent this week to 240 producers by Leon Henderson, Administrator of the Office of Price Administration. Fear that restrictions on the use of copper, nickel and other critical materials used in appliance manufacture might start a sharp upward movement in prices was said to motivate the request.

Products included in the OPA listing were irons, toasters, roasters, waffle irons, coffee makers, hot plates and grills, heaters and heating pads, warmers and sterilizers, vibrators, dryers, mixers and juicers, clocks, fans and shavers.

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Paraffin Prices Fixed

Paraffin wax has been placed under a formal price "ceiling" schedule effective December 1 by Price Administrator Henderson. The schedule virtually freezes existing charges for refined wax, but sharply reduces current prices for crude. For crude melting at between 122 and 124 degrees, a price ceiling of 4.25 cents per pound is fixed, with other grades varying in proportion. Refined grades melting at 123-125 degrees cannot be sold for more than 5.20 cents per pound.

Basing points, on which the maximum prices apply on an F.O.B. seller's shipping point basis, are established at Whiting, Ind.; New York City, Philadelphia, New Orleans, Baton Rouge and Texas gulf ports.

Government Ousts State from Oklahoma Project

Federal agency takes over Grand River development on orders from President — Heavy appropriations for hydro plants included in omnibus bill — OPM appeals for Douglas Dam

Hydro-electric projects made a big splash in the news last week. Invoking for the first time Section 16 of the Federal Water Power Act, the President ordered the Federal Works Agency to take over and operate for the duration of the war Oklahoma's 75,000-kw., PWA-financed Pensacola Dam on the Grand River. The House rivers and harbors committee divided sharply over the St. Lawrence waterway-power project, a majority voting to recommend authorization but agreeing to delay bringing the measure to a vote until next year. OPM made an "all-out" appeal for prompt Congressional approval of TVA's proposed 100,000-kw. Douglas Dam project on the French Broad river. House action was imminent on a $30,000,000 appropriation to advance by five years the Grand Coulee - Bonneville transmission line construction program to keep pace with a generation installation schedule stepped up by war requirements.

Grand River Disputes

The Grand River dam action is generally characterized as a "face-saving" for public power. Built by the Grand River Dam Authority, a state agency, with a federal loan and grant totaling $25,000,000, the project has been subject to varied disputes almost since its inception. The authority is in default on interest payments, is unable to float additional bonds to finance transmission lines, while its energy is counted upon to help serve numerous munitions plants and Army camps built or planned for the area. A large block of the energy is expected to be pooled with that of private companies to provide interim power for the government aluminum plant in Arkansas.

The President acted upon recommendation from the Federal Power Commission, which wants to see the project operated as part of a government pool of interconnected hydro projects on the White, Grand and Brazos rivers. Funds to begin construction of the Fort Gibson project on the Grand River are expected to be made available soon; construction of the Norfolk project on the White River (currently without authority for generator installations) is under way under U. S. Army Engineers' direction.

The St. Lawrence project, "pet" of the President, is included in the omnibus rivers and harbors bill, traditionally one of the major "pork barrel" measures of the session. In reporting the legislation, Chairman Mansfield (D., Texas) emphasized that none of the projects listed would be built until the President declared them required for defense—a declaration he has already repeatedly made regarding St. Lawrence.

Seven committee members signed a minority report opposing approval of the St. Lawrence project, keying their argument to the point that the peak of the defense effort will have passed before energy could possibly become available. With defense officials currently pursuing a two-three-year "victory program" which requires sidetracking everything which cannot contribute quickly to munitions output, this point brought out by the minority is certain to be the big issue in the House debate.

A flat delegation of authority to the Chief of Army Engineers to install hydro-electric generating equipment at any federal dam in his own discretion is proposed in the Omnibus rivers and harbors bill reported to the House.

Revised wording of the authorization provision of the bill permits the engineers to install penstocks and similar facilities in a dam after obtaining approval of the Secretary of War and the Federal Power Commission. The amended language then adds:

". . . and the Chief of Engineers is authorized in his discretion to construct power houses and install power machinery and appurtenances for the development of hydro-electric power at any dam heretofore or hereafter authorized by any act of Congress."

OPM Urges Douglas Dam

OPM's urging regarding the Douglas Dam project in Tennessee was an effort to stifle bitter opposition from Senator McKellar and many House members from that state prompted by farm interests whose rich land will be flooded by the storage reservoir. Over the signature of W. L. Batt, director of materials, OPM told the House that Douglas Dam is the only source "from which 100,000 kw. can be obtained within the time limits required." Present schedules call for TVA to move crew and machinery from its Cherokee Dam, nearing completion, to Douglas and completion of that project early in 1943.

Tied up in the $40,000,000 appropriation bill to start this dam also are funds to begin construction of Fontana Dam, which TVA recently acquired from Aluminum Co. of America, and two storage reservoirs.

Also in this appropriation measure is the $30,000,000 fund for Bonneville-Grand Coulee transmission lines which have OPM's approval. Current plans call for installation of nine 108,000-kw. generators at Coulee by the spring of 1944. The proposed lines will strengthen practically all sections of both the 230-kva. and the 115-kva. network to handle this huge volume of energy. The present $30,000,000 is designed to permit a start on all the projects at once; additional funds of slightly more than this amount are being budgeted for the Bonneville Power Administration's 1942-43 fiscal year account, which will come before Congress next spring.

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Ouster Right Legal, High Court Rules

In a far-reaching opinion, the Illinois Supreme Court this week ruled that municipalities of the state have the power to force public utilities to remove their poles and other equipment from city streets at the expiration of utility franchises.

Though the only two cities specifically mentioned in the case are Geneseo and Heyworth, in Henry and McLean counties, Springfield is directly affected, since the franchise of the Central Illinois Light Co. expired last August 15 and the City Council later adopted an ordinance ordering the company to remove its equipment. The ordinance was held in abeyance until the high court acted on the case.

The ruling was made on a rehearing granted the Illinois Northern Utilities Co., serving Geneseo, and the Central Illinois Electric & Gas Co., serving Heyworth. Holding that the Legislature had not given the Illinois Commerce Commission the power to regulate utilities in municipalities, the decision said:

> It is not for us to judge the propriety of legislation, but to construe the laws when enacted. The Legislature has not seen fit to say, in express language or by the enactment of directly conflicting provisions, that the control of occupancy of the streets of a city has been transferred to the Illinois Commerce Commission, and as we construe the law, it never did intend so to do.

REA Competition Keen for Defense Business

Two-million-pound supply of copper at Gilmer, Tex., transferred for use at Possum Kingdom hydro project gains priority rating — REA seeks additional defense contracts

The Rural Electrification Administration is actively competing with utility companies for power contracts with defense industries in the Southwest in the hope of forcing OPM into giving priority aid for REA's ambitious goal of a farmer cooperative economic empire built around electricity (ELECTRICAL WORLD, October 18, page 107).

The agency, set up by Congress for the purpose of helping farmers get low-cost rural lighting in uneconomic areas, already has a running start toward getting what it wants.

Through one of its "holding company" co-ops in Texas REA has obtained delivery of more than 2,000,000 lb. of copper wire for transmission lines which it purchased just ahead of tightening of priority restrictions. By turning its plans around REA now has obtained a specific priority allocation to complete the first step in its program.

Last July 28 the Farmers Electric Generating Co-operative, Inc., a co-op formed by seven distribution co-ops around Gilmer, Tex., awarded a contract to Sandburg and Johnson, Hampton, Iowa, for construction of 283 miles of transmission lines. The plan then was to tie together the seven distribution co-ops with a steam generating station of 7,500 kw. at Gilmer to another projected steam station of 7,500 kw. at Temple, Tex., and to Possum Kingdom hydro project, energy output of which REA co-ops have contracted to purchase.

Beats Allocation

Sandburg and Johnson obtained one bid for the wire and, the same day they got their contract, contracted to purchase the entire amount of conductor required for the job—this was before allocations were imposed on non-defense copper deliveries. All the copper was delivered by early September, before it could be used.

By September REA realized it could not complete its original program without priority aid in getting additional copper and steel, as well as for the generating units involved. Its project applications for this assistance had not been acted upon by OPM.

The Gilmer co-op, meanwhile, was actively in the market for defense power contracts in competition with Texas Power & Light Co., and claims it has several either signed up or in sight, one being a tool company at Garland City, another a military training center at Paris, both in T.P.&L. territory.

Somewhere in this period, with its 1,000 tons of vitally needed copper lying exposed and unused on the project site, subject to seizure by the government for defense, REA and the Gilmer co-op revised their plans and offered to use the copper to connect the Possum Kingdom hydro project, where power is being wasted now, with Gilmer and to the defense plants.

Wins Priority Rating

This proposal won a priority rating from Director Donald M. Nelson for the structural steel necessary to build a substation at the dam site. Construction of the transmission line with the copper wire on hand started at once.

With this victory REA is now pressing OPM's power unit—and Nelson directly—for additional ratings for the generators and other materials needed to add the other links in the original broader scheme. The agency is using defense power supply contracts, in hand and sought after, as support for further priority help.

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Utility-Bonneville Deal Hits Snag

With the approach of the expiration date, December 1, of Portland General Electric Co.'s contract with the Bonneville Administration for the purchase of Bonneville power, negotiations for a new contract are said to include a provision that the company shall sell its Clark County, Wash., and Woodburn, Ore., properties to the Clark County PUD and Woodburn municipal respectively at a price stipulated by Paul J. Raver, Bonneville Administrator, acting as negotiator. In addition, Dr. Raver stipulates that if the company is to get a long-term contract, it shall agree to the price at which the balance of its property can be purchased in its entirety, presumably dependent upon passage of federal legislation permitting such purchase.

At the same time Dr. Raver has announced that in the event a new contract is not negotiated he will not cut off the company's Bonneville supply, but will continue to serve its peaking requirements over and above what the company cannot generate in its own steam and hydro plants.

The company points to the coercive nature of these terms, stating that legal processes now exist through the courts if necessary for both Clark County and Woodburn to acquire the company's distribution systems in these places. The company states that since its Bonneville contract went into effect December 1, 1939, it has made rate reductions amounting to upward of $1,750,000 in anticipation that it would continue to be able to purchase a substantial quantity of Bonneville power to supply a part of its base load. If the company must now carry all its base load on its own generating plants, requiring the burning of oil for part of the year, its cost will be increased by approximately $400,000 per year.

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Governor Withholds Co-op Plant Approval

Gov. Frank Dixon of Alabama has declined to authorize construction of a $2,500,000 electric generating plant in south Alabama as proposed by the Alabama Electric Cooperative, Inc., unless the Supply Priorities and Allocations Board of OPM advises necessary metals can be spared from defense production.

"The attitude of REA is that of a pressure group," the Governor said. "I will not have it. I refuse to put pressure on OPM, SPAB or any other board charged with defense of this country." He added, however, that if SPAB held metals could be spared, then the project would be approved immediately.

A delegation called on the Governor November 19 and its spokesman, Charles Stakely, Montgomery attorney, contended the new plant would serve national defense, pointing out that because of a power shortage existing in the Southeast now curtailment has been necessary.

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Reject Labor Contract

The City Council of Richmond, Ind., has rejected unanimously a proposed labor contract submitted by the American Federation of State, County and Municipal Employees, under which the union would be sole bargaining agent for employees of the municipal power plant. Councilmen said the "Council has no legal right to enter into a labor contract." W. R. Stevens, plant manager, recommended the rejection. He denied the allegation that a majority of the plant employees were members of the union.

Quindaro Expansion to Include 30,000-Kw. Unit

Municipal plant at Kansas City, Kan., will meet defense loads with new turbo-generator and boiler, new circulating water system and extension of underground conduit

A $2,500,000 expansion of Quindaro power station No. 2 of the Board of Public Utilities, Kansas City, Kan., now under way, calls for the addition of a new 30,000-kw. Westinghouse turbo-generator and boiler, which by the end of 1942 will bring station capacity to 70,000 kw. Defense loads, including a new bomber assembly plant, imposed on normal load growth, made this improvement program necessary sooner than was originally planned, it is stated.

The building addition will contain space for the new unit and a future 30,000-kw. unit. A new boiler is a B & W 180,000-lb.-per-hour pulverized coal fired Stirling type steam-generating unit. Space is being provided in the building for two future units.

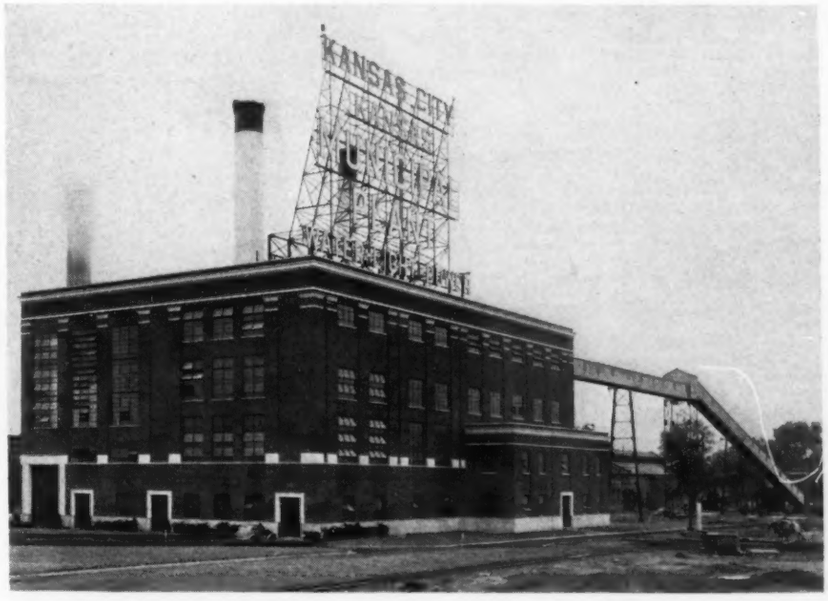
Switchgear for the new improvement will be Westinghouse metal-clad, similar to that already installed. Main 13,800-volt switchgear is of the synchronizing bus arrangement, with duplicate metal-clad switchgear structures for each generator section, but with only a single synchronizing and reactor structure. Each switchgear section is completely phase isolated and is provided with an extensive ground fault protective scheme. Breakers are 50,000 kva.

Circulating water for the present power stations and for the city's water supply system is taken out of the Missouri River. As the existing river intake and low service pumping station are inadequate to supply the additional raw water requirements for the new or future units, a new low service pumping station and circulating water system is included under the present improvement program. Two 42,000-g.p.m. slow-speed horizontal centrifugal pumps, driven by 1,000-hp. synchronous motors, are being installed to handle the extremely muddy water and to operate over the wide range of head conditions required. Space is provided for a future pump. Switchgear in the new low service station will be metal clad, with truck type 2,400-volt air circuit breakers.

The new circulating water system and other plant facilities are being designed for operation with a river level 12 ft. higher than the disastrous 1903 flood.

Burns & McDonnell Engineering Co. of Kansas City is the designing engineer for the generating station improvements.

The Board of Public Utilities recently completed an underground conduit line to serve the new bomber assembly plant. A study is also being made for approximately 23,000 ft. of underground conduit line to be installed from the Quindaro generating station to a heavy industrial section now being served by overhead lines.



EXPAND QUINDARO PLANT—Extension of the plant building to house the new 30,000-kw. turbine and boiler of this Kansas City, Kan., municipal plant will extend beyond the bend in the coal conveyor at right. New unit, ready in late 1942, will bring plant capacity to 70,000 kw. Project will cost $2,500,000

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Query Utilities on 1942 Requirements

OPM's Power Branch is preparing a detailed questionnaire for all utilities on their 1942 requirements of materials for repair, maintenance, operation and improvements. Also to be asked are questions regarding present inventories. The questionnaire will be ready for distribution some time next month.

Purpose of the inquiry is to give OPM data from which to compute the scarce materials requirements of the industry for at least a year ahead. This is one phase of an over-all program initiated by the Supply Priorities and Allocations Board, applying to all industries.

SPAB has directed each of the OPM industry branches to develop comprehensive 1942 programs in terms of materials requirements for both capital improvements and repair and maintenance. These programs are to become the basis for allocating supplies of raw materials of which there are not enough to go around.

Coincident with the inauguration of this planning program, OPM is making available to companies producing defense or essential civilian products and equipment a new and simplified priority plan by which a manufacturer may obtain a single rating for all critical materials for three-month periods. To be known as the Production Requirements Plan, this arrangement will replace and enlarge the scope of the Defense Supplies Rating Plan. Application for use of this plan, which will start with the first quarter of 1942, is made on Form PD-25a, obtainable from OPM Priorities Division, Washington.

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Consolidated Edison Men Seek Wage Arbitration

Negotiations between the Consolidated Edison System of New York and the Brotherhood of Consolidated Edison Employees, an independent union, reached an impasse this week and it was decided to submit the union's wage increase demands to arbitration.

The company has offered to increase wages by $1,000,000, but the union asks $7,000,000. No strike action is anticipated because an agreement running to October, 1943, provides that all differences which cannot be settled directly must be arbitrated.

Uebelacker to Head OPM Copper Branch

D. A. Uebelacker, who is on leave from his post with Ford, Bacon & Davis, is now chief of OPM's important copper commodity branch. He replaces John A. Church, a consulting mining engineer, who will be chief consultant for the unit.

Louis Jordan, who had been Mr. Uebelacker's assistant in the OPM nickel branch, is now acting chief of that division and is expected to retain that assignment indefinitely.

The shift in personnel is the first major change in OPM's metals commodity sections. It was made primarily because the work of the copper branch, including allocation of supplies, is considered to have broadened far beyond its original scope, which dealt chiefly with problems of supply. Mr. Church stays to continue this phase of the work.

•

Furnace Manufacturers Gain A-1-c Priority

Manufacturers of electric and combustion furnaces used in the heat treatment of metals have been granted an A-1-c rating to assist them in obtaining specified component materials for production of equipment and for operation of their foundries. The order is No. P-74 and it permits self-assignment of the rating by manufacturers after filing formal acceptance of its provisions. Monthly reports are required on Form PD-81.

The rating covers motors and other electrical accessories, mechanical parts and accessories, alloy and carbon steel, ferrous and non-ferrous castings and forgings, abrasives, indicating instruments and accessories, refractories and insulation, controlled atmosphere generators and accessories, burners and accessories, paints and finishing materials. Operating supplies consisting of steel rails and other steel scrap, silvery pig iron, regular pig iron, coke, ferrosilicon, ferro-manganese, vanadium, nickel, molybdenum and chromium also are covered.

•

Senate Holds Up Treaty on Niagara Diversion

The Senate returned to its foreign relations committee this week for further study a new treaty with Canada permitting the diversion for power purposes of additional water from the Niagara River. The action was taken after several Senators said the language of the agreement might be construed as giving sanction to development of the St. Lawrence seaway and power project.

Chairman Mansfield of the House rivers and harbors committee stated last week that the omnibus water and power project bill, which includes the St. Lawrence Seaway, would not be called up in the House until January.

•

Jersey Utility Group Meets in Atlantic City

New Jersey Utilities Association closed its annual convention last week in Atlantic City with the election of William H. Roth of Philadelphia, the secretary-treasurer, as president. Mr. Roth succeeded John A. Riggins of Haddonfield, who in turn became secretary-treasurer. A. T. Luce of Metuchen was elected vice-president.

The association named Harry Bacharach, formerly chairman of the New Jersey Public Utility Commission and former Mayor of Atlantic City, executive director of its information committee.

•

Detroit Societies Move

Announcement has been made that the Engineering Society of Detroit and the Detroit office of the Engineering Societies Personnel Service, Inc., will move their executive offices from the Hotel Statler to permanent headquarters in the Horace H. Rackham Educational Memorial, 100 Farnsworth Avenue, effective December 1.

MEETINGS

American Society of Agricultural Engineers—Fall meeting, Stevens Hotel, Chicago, Ill., December 1-3. Raymond Olney, secretary, St. Joseph, Mich.

American Society of Mechanical Engineers—Annual meeting, Hotel Astor, New York, N. Y., December 1-5. C. E. Davies, national secretary, 29 West 39th St., New York, N. Y.

Exposition of Chemical Industries—Grand Central Palace, New York, N. Y., December 1-6.

National Association of Manufacturers—Congress of American Industry, Waldorf Astoria Hotel, New York, N. Y., December 1-5.

American Institute of Electrical Engineers—Southern district, St. Charles Hotel, New Orleans, La., December 3-5; winter convention, New York, N. Y., January 26-30. H. H. Henline, national secretary, 29 West 39th St., New York, N. Y.

Petroleum Electric Power Association—Annual conference, Baker Hotel, Dallas, Tex., December 4-5. K. K. Kreamer, Petroleum Electric Power Association, Houston, Tex.

Louisiana Engineering Society—Annual meeting, St. Charles Hotel, New Orleans, La., January 9-10. J. K. Mayer, secretary-treasurer, Suite 422, St. Charles Hotel, New Orleans, La.

Missouri Valley Electric Association—Power sales conference, Continental Hotel, Kansas City, Mo., January 15-16. L. D. Pettegrew, director, 1527 Sharp Building, Lincoln, Neb.

American Society of Heating and Ventilating Engineers—Annual meeting, Philadelphia, Pa., January 26-30. A. V. Hutchinson, secretary, 51 Madison Av., New York.

International Heating & Ventilating Exposition—Biennial exposition, Commercial Museum, Philadelphia, Pa., January 26-30.

Material Shortages Halt Line Extension

J. A. Forney, manager of the Charlotte branch of Duke Power Co., said recently that shortage of copper, aluminum and other defense materials had brought power line extensions in the Charlotte area to a virtual standstill.

Utilities officials admitted that the same handicap was slowing down construction on new telephone lines.

Manager Forney says extension of power facilities to unserved areas in rural sections, which has been making rapid strides for Duke Power Co. in the past two years, will no longer be possible until essential materials are again made available.

It has been the policy of Duke Power Co., says Mr. Forney, to award contracts to outside firms for major line construction outside the city of Charlotte and to employ only such linemen as could be given regular work. However, the Duke company expects to be able to provide sufficient repair and maintenance work to keep the present crews busy.

Just now, says Mr. Forney, it is only possible under federal priorities to obtain sufficient materials to keep the company's properties in good working condition after wear and tear and damage has made further use of such property unfit or unsafe.

Rural electrification authorities, which operate directly under federal supervision, are also having difficulty obtaining materials.

•

TVA Rates Barred from Municipal Area

The Tennessee Railroad and Public Utilities Commission announced last week that it had denied a petition of the Kentucky Tennessee Light & Power Company to cut its rates in Jellico, Tenn., to the levels charged by the Tennessee Valley Authority. Jellico has a municipal power system.

One member of the Tennessee commission said the real issue was whether the private utility should be permitted to "force out of business its publicly owned competitor in a small community that is unable to support competitive service."

This commissioner said the private company's proposed rates would have been "unremunerative," but could have been borne by the utility because it operates extensively in adjacent areas in another state, Kentucky.

The city of Jellico charged that the utility's proposal was not made in good faith.

Output Drops During Thanksgiving Week

The amount of electrical energy distributed by the electric light and power industry for the week ended Saturday, November 22, was 3,205,034,000 kw.-hr., according to the Edison Electric Institute, a drop of approximately 100,000,000 kw.-hr. due to the Thanksgiving holiday observance in many states.

This decrease is much larger than that experienced in corresponding weeks of 1940 and 1939, but still is less than the 1941 declines over Labor Day and over the Fourth of July weeks, which were 128,000,000 kw.-hr. and 250,000,000 kw.-hr. respectively.

Nationally the percentage increases over 1940 dropped to 12.9, compared to a previous range of 15 to 18 percent. Running against this trend were the Rocky Mountain division, which increased 17.4 percent, and the Mid-Atlantic, up 11.2 percent.

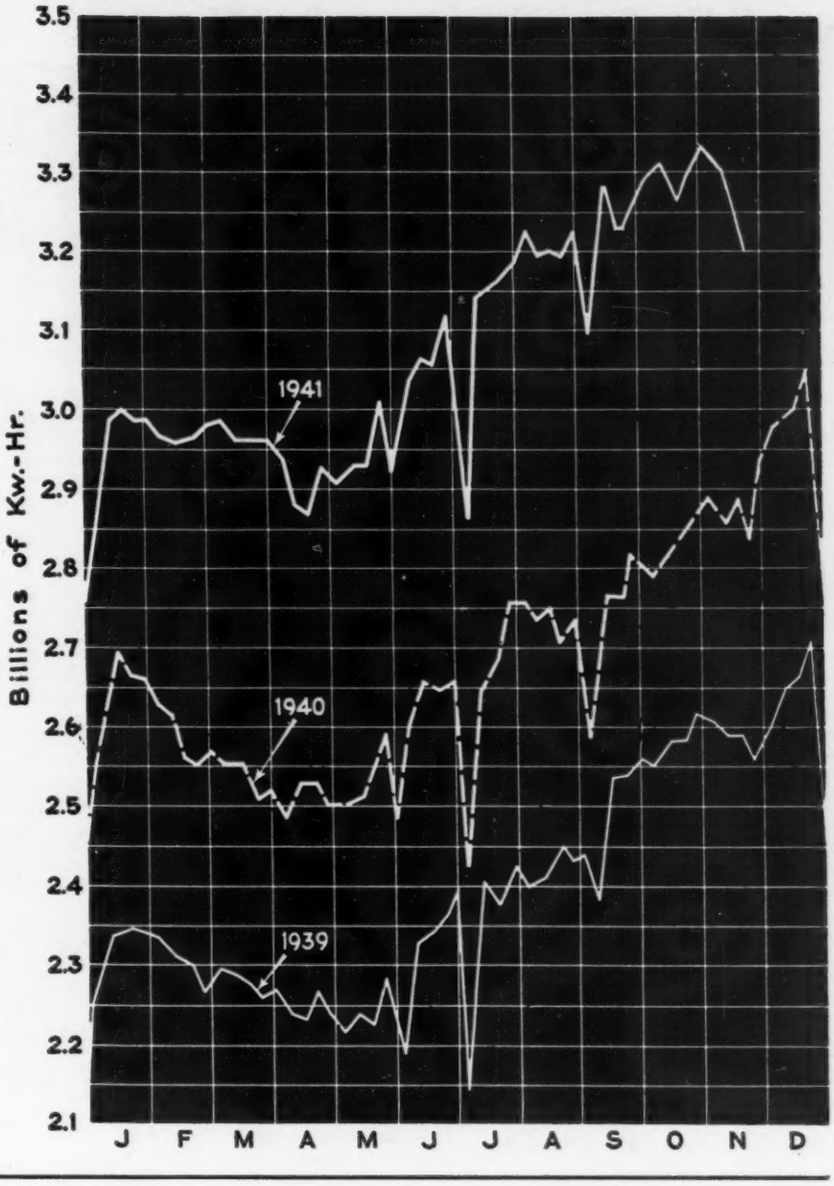
Weekly Output, Millions Kw.-Hr.

1941		1940		1939	
Nov. 22	3,205	Nov. 23	2,839	Nov. 25	2,561
Nov. 15	3,304	Nov. 16	2,890	Nov. 18	2,587
Nov. 8	3,325	Nov. 9	2,858	Nov. 11	2,589
Nov. 1	3,338	Nov. 2	2,882	Nov. 4	2,608
Oct. 25	3,299	Oct. 26	2,867	Oct. 28	2,622
Oct. 18	3,273	Oct. 19	2,838	Oct. 21	2,576

Percent Change from Previous Year

	Week Ending		
	Nov. 22	Nov. 15	Nov. 8
New England	+ 9.5	+15.7	+18.7
Mid-Atlantic	+11.2	+10.4	+14.0
Central Industrial	+14.5	+16.8	+18.5
West Central	+14.8	+15.9	+17.8
Southern States	+13.0	+14.3	+17.3
Rocky Mountain	+17.4	+16.9	+16.3
Pacific Coast	*+10.5	*+12.2	*+11.1
Total United States	+12.9	+14.3	+16.4

*Percentage should be higher — data under revision.



Energy Production Rises 17 Percent

Electric energy produced for public use in October, 1941, totaled 14,991,953,000 kw.-hr., an increase of 17 percent over production in October, 1940, according to a report issued by the Federal Power Commission.

This is the third month during which the daily average production of electric energy exceeded the half-billion kilowatt-hour mark and also the third consecutive month when average reached an all-time high. Average daily production of electric energy for public use in October was 515,187,000 kw.-hr., an increase of 1.4 percent over average daily production during the previous month. Production by water power in October amounted to 4,182,949,000 kw.-hr., or 27.9 percent of the total output for public use.

For the twelve months ended October 31, the publication shows, total production was 161,045,000,000 kw.-hr., an increase of 15.1 percent over the 139,901,000,000 kw.-hr. produced in the twelve months ended October 31, 1940.

The capacity of generating plants in service in the United States on October 31, 1941, totaled 43,412,706 kw., a net increase of 455,670 kw. over generating capacity reported in service on September 30.

•

City Gets FPC Approval

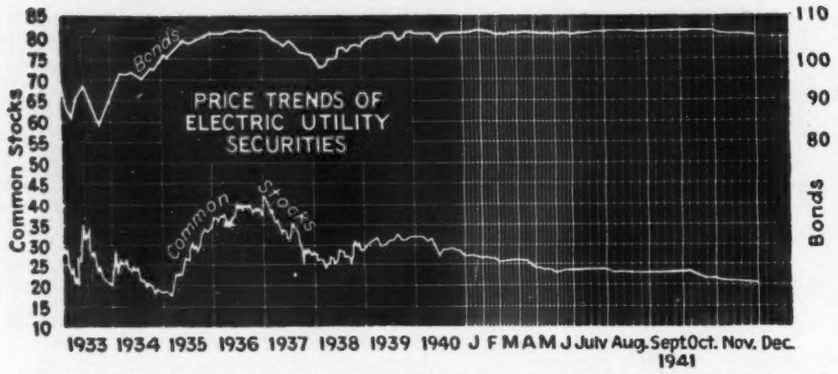
Federal Power Commission has ruled that the construction and operation of a proposed water power project on the Bear River in Emmett County, Michigan, by the city of Petoskey will not affect the interest of interstate or foreign commerce nor involve any lands of the United States. No Federal license will be required for the development, which will have an installed capacity of 750 hp.

•

Coal Used in October

Consumption of coal by electric utility plants in the United States reached an all-time high during the month of October, the Federal Power Commission has reported. Coal consumed amounted to 6,218,064 tons in October, as compared with 5,817,307 during the previous month, and 5,067,231 during October a year ago. Total stock of coal on hand at electric utility power plants on November 1, 1941, was 13,290,566 tons, a 2.6 percent increase over the stock on hand October 1, 1941, and a 6.2 percent increase compared to the stock on hand November 1, 1940.

Utility Stocks Dip; Bonds Turn Upward


PRICE TRENDS OF
ELECTRIC UTILITY
SECURITIES
Bonds
Common Stocks
Common Stocks
Bonds
85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10
110 100 90 80
1933 1934 1935 1936 1937 1938 1939 1940 J F M A M J July Aug. Sept. Oct. Nov. Dec. 1941

Slight changes in the prices of electric light and power stocks during the past week carried the "Electrical World" index down to 20.7; last week, 20.8; last year, 27.0. Bonds turned upward—105.7; last week, 105.5; last year, 106.2

United Light Files Liquidating Plan

Comprehensive plan for the liquidation of the United Light & Power Co., top holding unit in a system with more than $500,000,000 of utility assets, was filed this week by the company with the SEC. The company proposes to pay off its outstanding debentures, have its remaining debt assumed by Iowa-Illinois Gas & Electric Co., a new operating utility company, and then dissolve.

Dissolution of United Light & Power was ordered by the commission on March 20, with that of the United American Co., an intermediate holding company.

•

Would Amend Utility Act

A bill to remove from the anti-lobbying provisions of the Holding Company Act the restriction on Congressional contacts of officers and directors of registered holding companies and their operating subsidiaries was introduced this week by Representative George A. Paddock of Illinois. The law now prevents such officers from conferring with members of Congress regarding utility legislation without first filing certain information with the SEC.

•

Utah City to Construct Unit on Beaver River

Federal Power Commission has issued a major license to Beaver City, Utah, for the construction of a hydroelectric project on the Beaver River, Beaver County, Utah, affecting lands of the United States in Fishlake National Forest. Included in the project are a power house having installed capacity of 750 hp. and a 6,900-volt transmission line about 4.1 miles long extending from the power house to a substation near the city limits of Beaver City.

Energy generated will be used mainly to supply the domestic and industrial requirements of Beaver City and the rural electrification requirements of Beaver Valley Electric Association, Inc.

•

Opposes Liquidation in Associated Plan

Sharp differences of opinion have cropped up between Stanley Clarke, trustee in reorganization of Associated Gas & Electric Co., and Willard L. Thorp and Denis J. Driscoll, trustees in reorganization of the Associated Gas & Electric Corp., in connection with the sale of certain large utility properties as proposed in the plan recently filed by the corporation trustees with the court (ELECTRICAL WORLD, November 8, page 9).

In their plan the corporation trustees had recommended the eventual sale of Associated's equities in, among others, Rochester Gas & Electric Corp., Jersey Central Power & Light Co., Virginia Public Service Co. and Staten Island Edison Co. Mr. Clarke stated that if properties were disposed of now, at depressed prices for utility securities, "millions of dollars of value will have been sacrified and the security holders will have suffered irreparable damage."

Instead of selling the Rochester, Jersey Central and Staten Island companies, Mr. Clarke suggested that the corporation trustees issue five-year 3 percent certificates in the amount of $22,000,000, which approximates the amount which would be realized from the sale of the three properties.

If they were sold, Mr. Clarke pointed out, their earning power of $2,457,000 would be lost permanently, whereas the annual interest charge required to borrow an equivalent amount of money would be only $660,000, a net difference in favor of borrowing of about $1,800,000.

•

Public Service Wins Stay Against SEC

The United States Circuit Court of Appeals last week directed the Securities and Exchange Commission to defer imposition of its orders, issued September 15, against Public Service Corp. of New Jersey pending outcome of the company's appeal from the SEC requirements.

In a finding on September 15 SEC had declared that Public Service was a subsidiary of United Gas Improvement Co. and of United Corp. and therefore subject to the provisions of the Holding Company Act of 1935.

The company protested against this decision and appealed to the court for relief (ELECTRICAL WORLD, November 22, 1941, page 20). A stay order was signed last week by Judge William Clark and the company was instructed to give the SEC "due notice in advance of any contemplated action" which might be subject to the holding company act.

•

Seeks City Plant Tie-In

Central New York Power Corp. has offered to the Potsdam, N. Y., village board a plan for taking over the village light and power plant to tie in with the utility company for one year. Proposal calls for the village to turn over its entire generating output for one year to the power company, but operate the plant with the present staff. In return the village would receive $575 per month and a lower rate on the power used by the village, all of which would be purchased from the utility.

Utility Reports

	Net Income 1941	1940
*Birmingham Electric	$786,436	$554,235
*Calif. Oregon Power	952,670	909,265
*Central Ariz. Lt. & Pwr.	634,234	897,141
*Columbia Gas & Electric and subs.	11,043,779	12,653,020
†Detroit Edison and subs.	12,344,012	10,294,076
*Mississippi Power & Lt.	364,388	474,251
*N. Y. Power & Light	3,191,878	3,194,494
*Niagara Falls Power and subs.	2,912,623	2,767,545
*Niagara Hudson Power and subs.	16,415,600	15,082,443
*Niagara, Lockport & Ont. Pwr. and subs.	1,172,437	1,373,995
*Northwestern Electric	497,321	491,377
*Pacific Power & Light and sub.	821,707	862,801
†Public Service of N. J. and subs.	21,079,881	23,221,694

*Twelve months ended September 30.
†Twelve months ended October 31.

CALL ON THESE "RED CAPS"

To Give Metropolitan Service on Your Rural Lines

FP-119 Reclosers on the Assembly Line

YOU'LL save money—and take a load off your mind as well—by installing FP-119 circuit reclosers on your rural lines. Scores of operators, from Canada to tropical Puerto Rico, have done so. They find that these reclosers provide continued service through as many as 90 per cent of their line faults.

FP-119 reclosers, they report, give real service!—by automatically restoring power immediately after interrupting the circuit to clear transitory faults. Recently, during a severe electrical storm in South Carolina, one of these reclosers cleared *16 line faults* during a single night—and promptly restored service every time!

136 LINE FAULTS—*only three sustained outages*

And from Rushville, Ind., A. M. Miller of the Southeastern Indiana Power Company writes, "Results were so gratifying that we purchased three more FP-119's. We now have a three-month record and it reveals that we have had 136 operations in this period. Three of these were lockouts caused by limbs falling over the lines. On the remaining 133 we never knew when a fault occurred, as we had no outages at all."

Performance like this has caused the demand for FP-119 reclosers. And this increasing demand, together with standardization and efficient production-line assembly methods, has, in turn, made possible still another reduction in price—to $99! Why not take advantage of this new low price, now? If you'd like more detailed information, just ask for Bulletin GEA-2846A. General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

857-4-7400

OPERATING PRACTICES

Load Control Boosts Station Efficiency

By equipping the new 35,000-kw., 3,600-r.p.m. turbo-generator at its Des Moines plant for automatic base-load control, Iowa Power & Light Company is making full use of the new machine's high efficiency to improve plant economy.

The new condensing turbine operates on steam at 1,290 psi. gage and 925 deg. F. from a 412,000-lb.-per-hour powdered-fuel boiler burning Iowa coal of characteristically high moisture content. Thermal efficiency of the new (1939) boiler-turbine combination is 12,500 B.t.u. per kw.-hr. output, as against 17,500 B.t.u. per kw.-hr. output for the older 20,000- and 30,000-kw. units in the low-pressure (350 psi. gage, 865 deg.) portion of the plant.

When the high-pressure turbine is carrying the base load of 30,000 to 35,000 kw. on the automatic control and the low-pressure units are operating as peak-load machines, station thermal efficiency is about 15,000 B.t.u. per kw.-hr. output.

The base-load control equipment consists of a recorder and controller. The load recorder is arranged to record the load carried on the base-load unit and, if desired, to control the load on this generator for a given value from the controller at the same time.

The particular controller setting varies with the time of year, operating condition of the boiler and the coal analysis. During winter months it is usually set at 30,000 to 32,000 kw.

Both the recorder and controller measuring circuits are connected to the d.c. output of a thermal converter connected to the current and potential transformers in the generator leads.

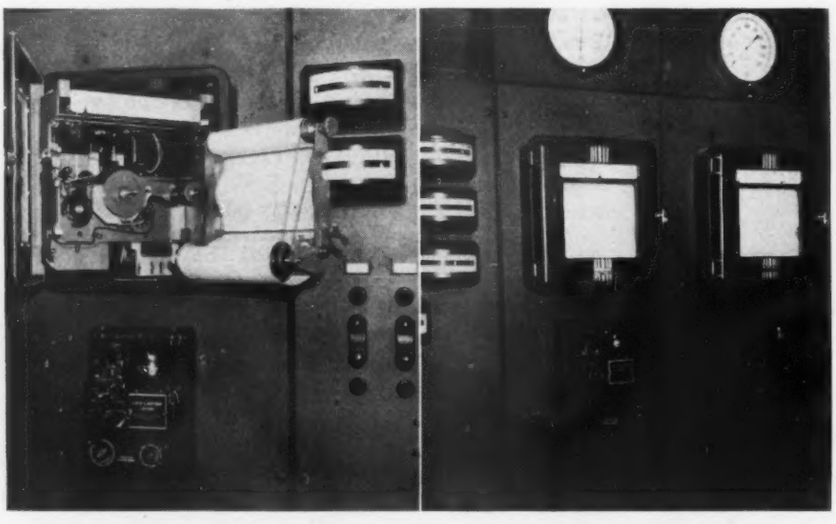
High and low limit contacts in the recorder can be set to any value within the recorder range. Opening of either high or low limit contact opens the circuit to the governor motor relay and no further impulses can go from the load controller to the governor motor relays.

When raise or lower contacts close in the controller impulses are sent to the governor relays to raise or lower the machine load.

Interrupters are provided in both the controller and recorder. Both are connected to one side of the supply to the governor motor relays. The interrupter in the recorder controls the time between impulses to the governor, while the controller interrupter determines the length of impulses which pass to the governor motor.

While the recorder can be operated independent of the controller, the controller cannot be operated without the recorder since it depends on the limit contacts and interrupter in the recorder for proper operation.

The automatic base-load control at Des Moines is operated in conjunction with an automatic L & N frequency control (and recorder) which is normally used on the peak-load units. While the base-load control can be used only on the new turbine, the frequency controller can be used on any of the three machines.



LEFT—Automatic base load control loads efficient new high-pressure unit at best operating point. Load recorder (top) is shown open and controller (bottom) with cover removed. Right—Frequency indicator and controller (left) is used in peak load units while load recorder and controller (right) maintains constant load on base-load machine

•

Pole Holes in Rock Made With Well Drill

In a residential area underlaid with rocky ledges, where use of dynamite to blast out pole holes would have

A WHOLE MONTH'S OPERATION AT ONE GLANCE

That's Why You'll Like the One-inch-per-day Chart Speed of This Instrument

THE low chart speed of our new portable recorder gives you a 30-day record (of current or voltage) on a 30-inch chart. This makes it easy to stretch out the entire chart on your desk and see, at one glance, the spread of current or voltage, as well as the duration of maximum and minimum values.

This eliminates the annoyance of having to handle 60 ft of chart (a month's record at the minimum chart speed previously available).

You can obtain this Type CF-1 recorder in both ammeters and voltmeters. Place your order today, and see for yourself how this instrument will simplify the work of analyzing your surveys. General Electric, Schenectady, N. Y.

IT'S INKLESS

1. Requires no attention during a month's operation.

2. No "lost" records, for there's no pen to clog and no ink to freeze or evaporate.

3. Records accurately in temperatures from −10 F to 120 F.

WHERE IT WILL PAY DIVIDENDS

1. For voltage surveys where constant vigilance is necessary in order to detect and correct trouble—thus assuring better service and protecting your revenue.

2. For load surveys of power-station equipment to be sure machines can carry their loads—thus protecting against burnouts.

3. For continuous checks of important transformers—thus guarding against burnouts.

HEADQUARTERS FOR ELECTRICAL MEASUREMENT

GENERAL ELECTRIC

resulted in inevitable and extensive damage, construction men of the Wisconsin Public Service Company at Green Bay called in a local well drilling contractor, equipped with a 16-in. drill, and turned the job over to him. The idea proved a profitable one for the twelve to fourteen holes were drilled at the rate of three to four a day for about $2 per hole under the cost of dynamiting.

•

Rats or Birds Can't Short This Bus

In connection with the establishment of two new circuits of 10,000-kva. capacity each at the South Meadow station at the Hartford Electric Light Company to serve outside loads at 22 kv., it was necessary to run two three-phase circuits from the 11-kv. buses in the station to outdoor type transformers about 40 ft. from the plant. From the station to the transformers 1¼-in. extra heavy IPS copper tubing mounted on insulators over conventional steel structures was used. In accordance with the company's usual practice, this tubing was supported at 8-ft. intervals with 18 in. between phases. Because the company's experience with bare tubing on similar applications was somewhat unsatisfactory on account of short circuits, it was decided to insulate this tubing with a 17-64-in. layer of "Flamenol" covering, which was supplied by General Electric.

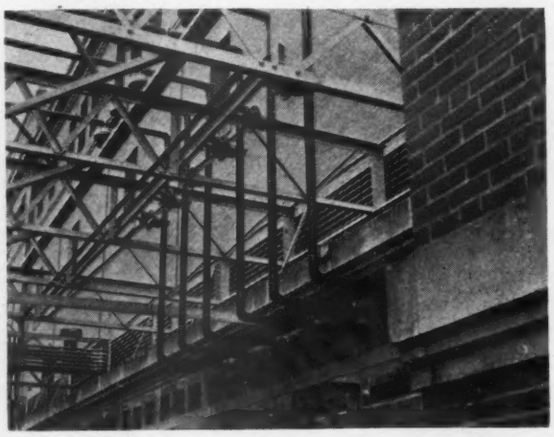
Short circuits were caused by rats running over the steel structure (11-kv. insulators are about 10 in. high) as well as by birds spanning the interphase distance.

The job called for 68 lengths each 20 ft. long. Inside diameter of the tubing was 1.25 in. and the outside diameter 1.66 in. Tube diameter over the insulation was 2.2 in. Compared with rubber, tape and braid, this covering was easier to manufacture, there being no curing problem as with rubber; only one operation was required; the material is highly resistant to the elements, unaffected by ozone, and there was no necessity for fibrous protective coverings which face the prospect of deterioration within a relatively short time.

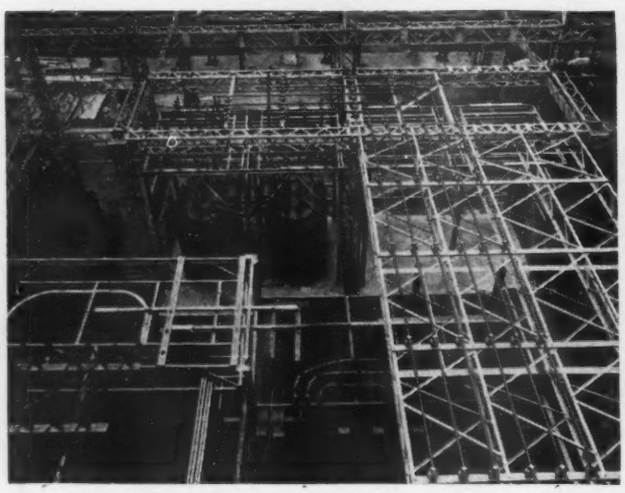
To support the insulated tubings on the insulators it was decided to provide special bus support fittings to insure against excessive deformation of the Flamenol insulation due to localized pressure. All edges were rounded off in these fittings. To connect the 20-ft. lengths of insulated tubing so that the joints would be satisfactorily insulated, a special no-bolt internal expansion connector was developed by the Sheldon Service Corporation. The following method of insulating over the connectors was used:

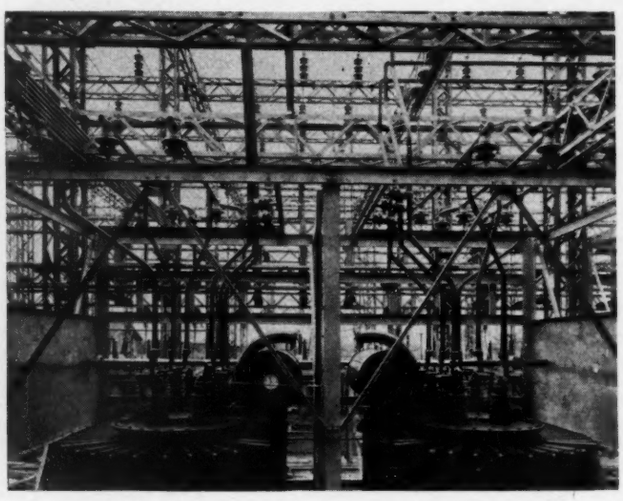
After penciling the insulation on both sides of the conductor the insulation end connector was painted with No. 1202 clear insulating varnish. Allowing about ten minutes for the solvent in the varnish to evaporate, sufficient Coronal tape was applied to build up the entire thickness of the insulation. A layer of friction tape was then applied, half-lap, followed by a generous layer of 1242 black Glyptal varnish and a layer of glass woven tape, half lap. There was a final dousing with 1242 black Glyptal varnish. This final covering of glass tape was made at the suggestion of the utility, as it would not deteriorate when exposed to the elements in a relatively short time. It was found that the insulated tubing could be very satisfactorily bent with a conventional hydraulic pipe bender into the required shapes. The sharpest bend each phase was given was a right-angle turn around 15 in. radius. The insulation was not injured by the force required to produce such a bend.

Results have been satisfactory since the installation and, aside from protection against rats and birds, gives an improved appearance. It is estimated that the entire cost of the job was increased about 3.5 percent by the use of insulated tubing rather than bare.



INSULATED connectors leaving generating plant





TOP OF outdoor bus structure and six 11-kv. insulated connections (left). Insulated tubing entering transformer primaries (right)

THEY ALL FIT

THIS HOUSING

G-E INTERCHANGEABILITY GIVES **3** CUTOUTS IN ONE...

CHANGING a *General Electric* fuse cutout is a matter of minutes—just hook a different door on the housing.

Suppose you've already installed G-E single-element cutouts and want to convert them to reclosing cutouts to reduce outages. All you do is send your linemen out to swap doors. The reclosing door contains the complete mechanism. And with the new G-E jumper stick, the change-over takes only a minute.

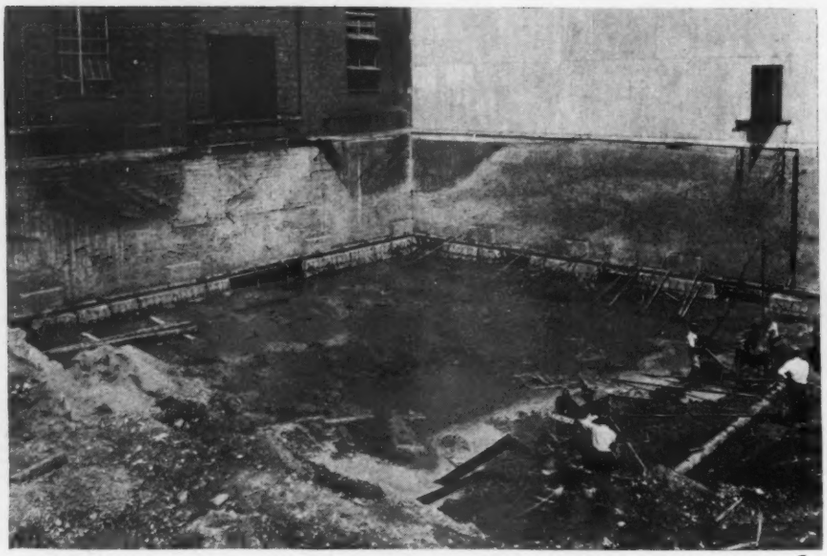
Do the same to convert to disconnects. Just change doors. You get a *new* kind of disconnect, too, with a flexible, can't-be-lost blade, an indicating feature for easy spotting, and an isolating feature for greater safety.

Here's still more flexibility. All three doors (single-element, reclosing, and disconnect) will fit the housings of both the 5-kv and the 7.5-kv cutouts. This 5-item combination, in the 50-amp rating, *will fill 80 per cent of all* distribution cutout requirements. (And there's a similar 2-housing 3-door combination in the 100-amp rating to take care of the other 20 per cent.) Two housings. Three doors. All interchangeable. And both the complete cutouts and the separate doors are stocked for prompt deliveries. We say "It can't be beat!"

Write for Bulletin GEA-3448. General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

406-7-5254



WELL POINTS connected to above-ground suction header de-water excavation for Harding Street plant extension at Indianapolis. Note 2,000 g.p.m. suction pump at lower right

De-watering System Keeps Excavation Dry

All excavated material below normal ground water level was removed in dry form during excavation for the new extension to the Harding Street power plant of Indianapolis Power & Light Company, (ELECTRICAL WORLD, Nov. 1, 1941, p. 62). To accomplish this a de-watering system was employed which made it unnecessary to drive sheathing around excavation or sink a sump to de-water the area.

In this instance the excavation was de-watered by using a system of well points driven into the ground around the area and connected above ground to a motor-driven suction pump. The pump removed the ground water and left the earth dry and easy to handle.

Well points consisted of 2-in. pipe with screen at the lower end and long enough to project into the ground to a depth of 6 to 7 ft. below the lowest point of excavation. These points were jetted into the ground by forcing water under high pressure through the lower end of the pipe, thus forcing the earth aside and allowing the points to be lowered to desired depth.

Points were placed on about 6-ft. centers in a straight line and connected above ground to an 8-in. header pipe. This pipe was in turn connected to two motor-driven suction pumps, each having a capacity of 2,000 g.p.m. Water was discharged at a point about 300 ft. distant.

Pumps operated continuously, day and night, seven days a week, till the excavation was completed, piling driven, footing, concrete wall and sub slab in place, keeping the basement watertight.

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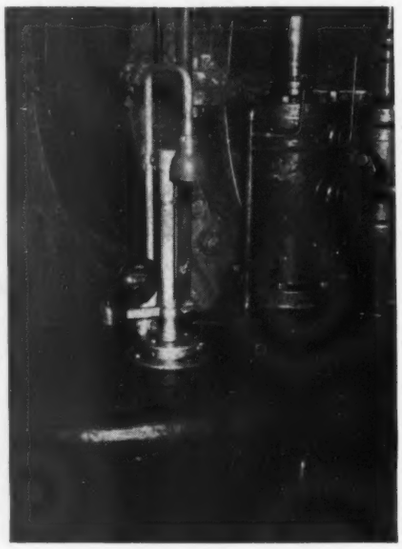
Device Signals Turbine Oil Level



Continuous visual indication of turbine oil level and an audible warning of low oil level are given by a simple device used on turbines at the Omaha plant of the Nebraska Power Company. Float in the turbine oil reservoir is provided with a rod extension that is coupled to a Mercoid tilt tube. This switch operates a signal horn and lamp atop the turbine when level drops one inch. Target on the rod gives visual indication of oil level at all times. Gooseneck carries a lamp to light the scale on the float rod housing.

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Cable Coating Cuts Sheath Corrosion*

To the mechanical protection afforded buried lead-covered power cables by use of asphalt coatings—intended to prevent particles of soil from contacting the sheath and setting up oxygen concentration cells—Detroit Edison Company has added a corrosion inhibiting treatment through addition of 1 percent by volume of sodium silicate and sodium dichromate in ten gallons of clay-base type emulsified asphalt.

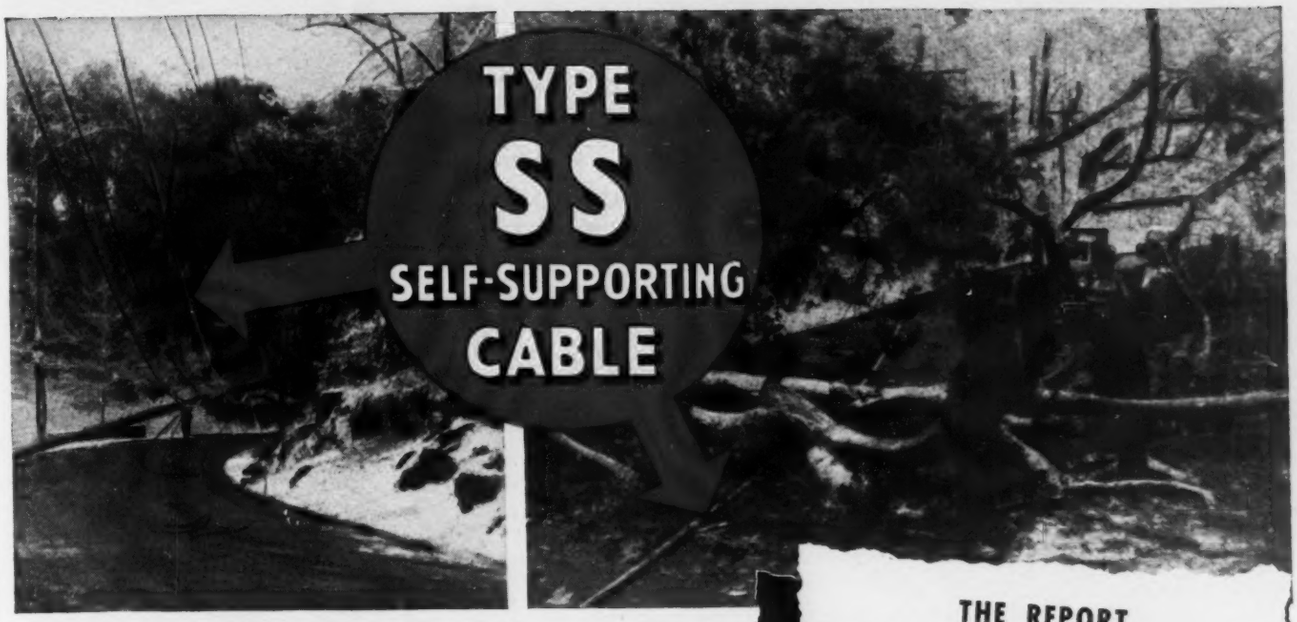
The neutralized solution of sodium dichromate is prepared by dissolving the dichromate crystals in only enough water to give a saturated solution, then converting it to a neutral sodium-chromate solution through addition of sodium hydroxide. The dichromate solution has a red color which turns to the characteristic yellow of sodium chromate as the solution is neutralized. Since the acid dichromate without its neutralization to a chromate would both precipitate the asphalt emulsion and cause the silicate to gel, it is important to follow instructions carefully. Compound is dark brown in color with the consistency of thick cream and it dries in one hour or less.

About one one-thousandth percent of a solution of silicate or one-half percent of chromate is sufficient to protect a lead sheath against corrosive action. By test, a combination has been found better than either alone. Excess chemical is provided so that the amount necessary will gradually seep out of the coating and provide a protective film for a long time.

Because this cable-coating material is used the year around, alcohol (about 5 percent) is added during preparation to prohibit freezing to as low as zero Fahrenheit. Otherwise, the material will not function properly at a temperature lower than 45 deg.

Although accurate prediction of life of cables protected with this coating is not possible, the company finds the coating entirely satisfactory from the standpoint of cost, ease of application and apparent protective effect.

* Based on a paper presented recently by W. D. Sanderson, Detroit Edison, to the underground group of the transmission and distribution committee, E.E.I.



UNDAMAGED

It Picked Up the Load!

HERE'S the report of an experience with Type SS aerial cable which again proves its ability to support service under snow, sleet, or high wind. Even when down with trees or poles across it as shown in the pictures!

Type SS makes possible these important advantages:

Long spans or use of short poles—or both.

Freedom from short circuits if in contact with trees or wires—thus there's little danger of shock or injury.

Practically no tree trimming necessary—therefore right of way is easier to obtain. The cable presents a better appearance than messenger-wire cable.

These and other advantages make Type SS the most economical choice for many types of urban, suburban, and rural circuits.

For power circuits. The two-conductor type serves single-phase circuits, with one side grounded, from 4000 to 15,000 volts. The four-conductor type is for three-phase, four-wire circuits, up to 5000 volts. The insulation is No. 1799 varnished cambric. A ground conductor is in the outer covering.

For control circuits. The multiple-conductor type is for telephone, supervisory, or other control circuits, of 300-volt rating, from 4 to 10 conductors. Thinwol, a General Electric compound of 85 per cent new rubber, is the insulation. The armor is used only for support and mechanical protection.

Have you seen our new Type SS bulletin? The number is GEA-2408A. Get a copy from the nearest G-E office. General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

501-3-1200

THE REPORT

(Digested from the power company's own account.)

Following hours of snowfall, during which we had aerial line trouble from over-weighted trees and limbs, a very large tree crashed, taking with it our three-phase aerial wire, two street-light wires, two telephone cables and messengers, and one newly installed 2/0 SS cable. Wires, SS cable, and cross-arms were stripped from the pole on the substation end of the span where the tree fell, and two poles were broken off beyond the span. Because of the electrical set-up at the time of fault, the circuit tripped, but after cutting clear the main aerial open-wire trouble, the circuit was re-energized and the SS cable picked up the load just thirty-four minutes after the initial interruption.

The SS cable was later returned to its proper position without showing any evidence of what had occurred other than the newly installed poles.

Our experience in installation and operation of the cable leads us to believe that we were correct in our design assumptions, and that the cable will do all that is expected of it.

ACCEPTANCE

Following is a summary of the orders placed by three representative power companies during the period 1936-40.

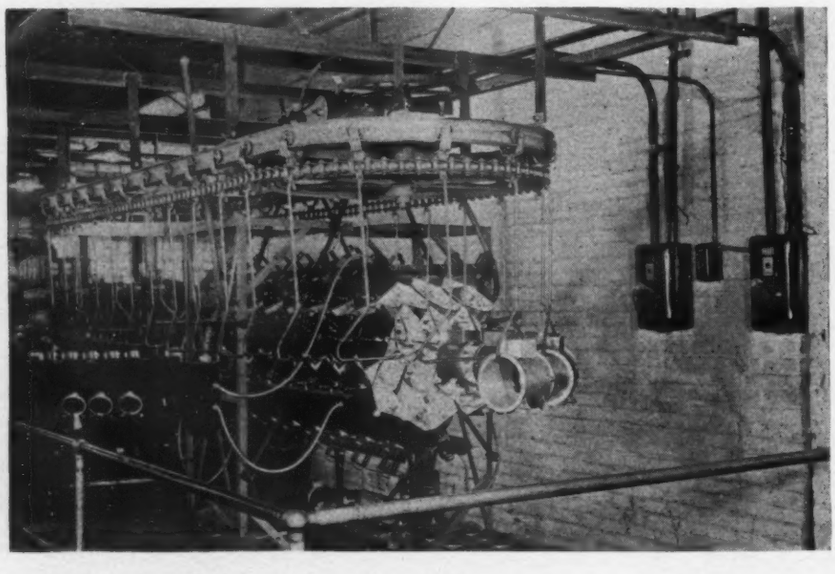
Company	Number of Repeat Orders	Total Feet Purchased
A (East)	9	170,000
B (Middle West)	11	56,500
C (Far West)	3	23,200

INDUSTRIAL ENGINEERING

Infra-Red Used for Shrinkage Fit

Rejects frequent in press fitting of aluminum and steel parts have been reduced by using infra-red heat for shrinkage fit. In the Westinghouse small motor plant at Lima, Ohio, a rotary conveyor traveling at the rate of 30 ft. per minute carries aluminum motor frames through a tunnel formed by a battery of 56 375-watt lamps. The aluminum frames are heated to 150 deg. C., which expands the 6¾-in. bore 0.020 in., enough to allow the wound primary to drop in place.

Using the infra-red heating method as suggested by Fred C. Gossett, supervisor of methods, tools and equipment, the shrink fit allowance is much larger than that practical for a press fit. Until this method was discovered the mechanical operation of obtaining proper fits between hard and soft metal parts had always been more or less unsatisfactory.



INFRA-RED LAMPS forming a tunnel heat aluminum motor parts for shrinkage fit

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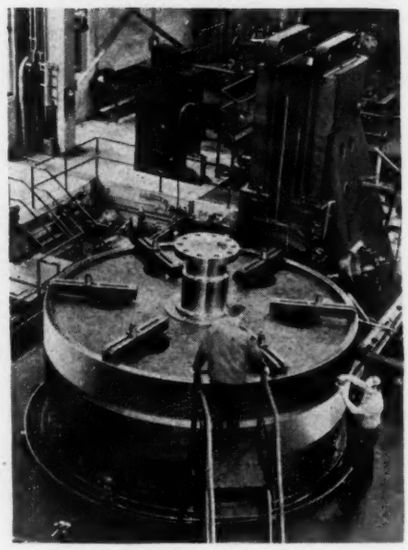
Continuous Power for Marine Gear Cutting

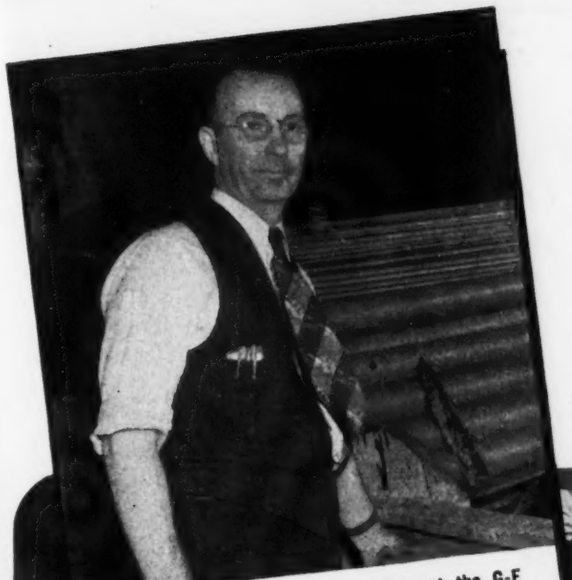
By A. A. ROSS
Gear Engineer, River Works,
General Electric Company, Lynn, Mass.

Marine gears for ship propulsion must be manufactured under conditions insuring watch-like precision, tolerances as close as 0.0003 in. being necessary even in gears weighing 35 tons and 200 in. in diameter. The allowable error in machining is a fraction of the thickness of a cigarette paper. The manufacture of the largest gear sets requires about ten months. Extreme care in manufacture is the price of successful service at sea, where steam turbine speeds range from 4,000 to 10,000 r.p.m. and propeller speeds for most efficient operation between 75 and 400 r.p.m. Continuous electrical supply is absolutely essential to the finish cutting of such gears, which might be ruined by interruption.



CUTTING TEETH in 163-in. bull gear
About 285 hours exclusive of "set-up" time is required to make one "rough" and one finish cut for each of the two rows of teeth. No interruption can be tolerated during the finish cutting

At the River Works of the General Electric Company in Lynn, 40 gear cutting machines in groups varying in sizes from 24 in. to 200 in. capacity are in service. The cutting or "hobbing" process is done in a special shop where precautions are taken to prevent temperature changes in excess of 5 deg. F. This is necessary to keep any expansion or contraction of the larger gears undergoing machining within almost infinitesimal limits. Large gears-to-be are not brought into the hobbing shop until their tempera-



C. J. Baish, 3-Department Foreman at the G-E Conduit Factory, New Kensington, Pa.

Mr. Baish is foreman of the "pickling", galvanizing and enameling departments. He started working in the factory 28 years ago and has had long, thorough experience in making conduit. There are 125 men in his departments.

The Quality of G-E Rigid Conduit Is Aided by "Pickling"

No. 2 of a series—Men and Processes Behind G-E Conduit

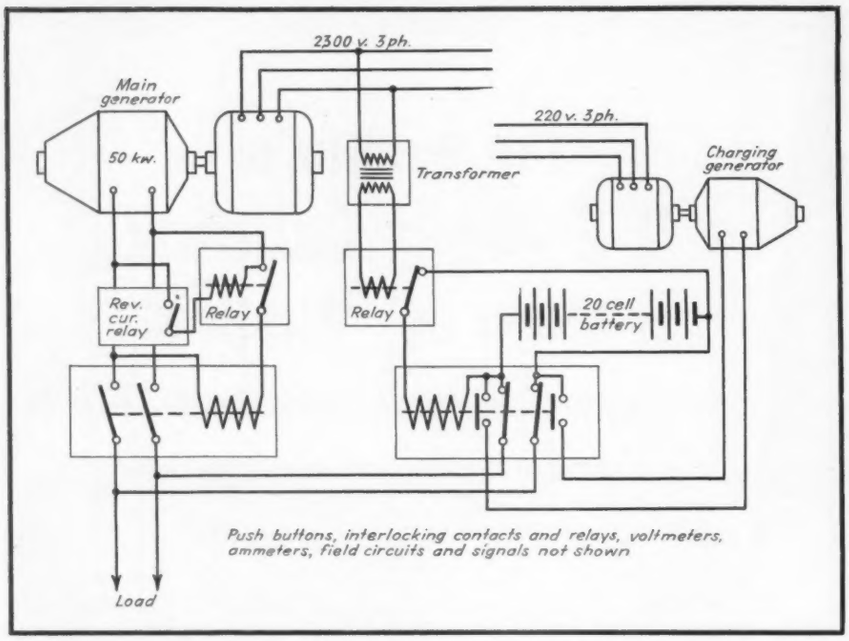
G-E Conduit in the exclusive G-E "Pickling" Machine

"PICKLING" is an important operation in the manufacture of G-E conduit, both G-E White and G-E Black. This chemical cleaning process prepares the mild steel tubing for further operations and lays the foundation for the uniform high quality of G-E Conduit. Thirty tons of tubing are chemically cleaned at one time by rotary action in the exclusive acid "pickling" machine designed by General Electric. Every piece of steel tubing is cleaned by the acid inside and out leaving the tubing free from rust and scale.

Skilled men guide this operation carefully, paying special attention to the proper loading of the machine and keeping a close check on the solution. After the "pickling" operation, the tubing is washed in cold and hot water and then dried and inspected against light. This careful chemical cleaning, prior to hot-dipped galvanizing or enameling, helps insure a lasting finish.

For further information, see the nearest G-E Merchandise Distributor or write to Section C-19A, General Electric Co., Appliance and Merchandise Dept., Bridgeport, Conn.

GENERAL ELECTRIC



SCHEMATIC DIAGRAM of emergency power supply to hobbing machine motors. In case of interrupted a.c. supply the storage battery automatically assumes the load without loss of speed in the gear cutters

ture has been brought to substantially that of the shop.

Three large hobbing machines (one 164 in. and two 200 in.) are driven by 250-volt, d.c. adjustable-speed motors, which in turn receive their energy from motor-generator sets having induction motor driving units run from the plant's 2,300-volt, three-phase, 60-cycle distribution system. The two 200-in. hobbing machines are each equipped with sixteen motors ranging from ¼ hp. to 30 hp. and totaling 105½ hp., of which 63¾ hp. is continuous load. The variety of motor applications required is shown in Table 1.

To avoid interruption of the power supply to the motors of the large hobbing machines a 120-cell Philco storage battery is provided. This is equipped with a 5-kw. motor-generator charging set and is at all times maintained in readiness for instant service. Normally the main motor-generator set of 50 kw. rating supplies all power required by the hobber, the battery being floated with its own motor-generator set to maintain fully charged condition. Failure of power to the main motor-generator set opens a potential relay, which in turn closes a normally open contactor connecting the battery directly to the hobber supply circuit. Reverse current relays at the same time disconnect the main motor-generator from the circuit.

The voltage of the motor-generator set and of the battery are maintained at equal value. The change-over to the emergency supply occurs so rapidly and smoothly that there is scarcely any noticeable change in the voltage on the supply line to the driving motors, and thus there are no fluctuations of consequence in the cutting speed. The battery, rated at 590 amp.-hr., will enable the motors to drive the hobbers at full speed until normal power is restored. Adjusting the motor-generator voltage to that of the battery permits restoration of the regular drive without undesirable speed changes.

A special 200-in. gap lathe in this gear manufacturing work is driven by a 30-hp. 575/1,725-r.p.m. variable-speed motor, formerly connected to the main power line, but slight voltage changes so affected the accuracy of the work that it was necessary to install a 40-kw. motor-generator for this machine.

Motor Requirements of 200-In. Hobber

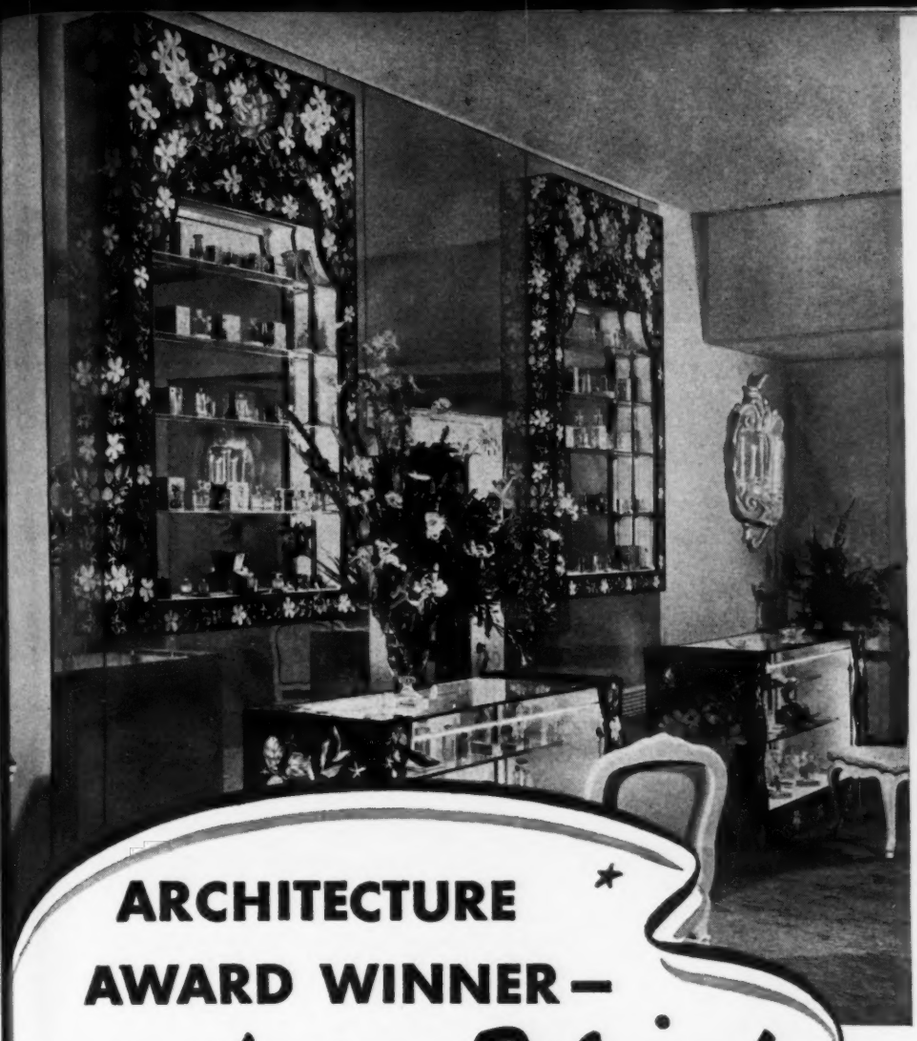
Service	Number	Rating, Hp.
Main drive	1	30
Rapid traverse to work table	1	30
Stanchion traverse	1	10
Spindle oil pumps	2	3
Coolant oil pumps	2	3
General lubrication pumps	2	3
Change gear box	1	¾
Cuno oil filters	3	¼
Oil sump pump	1	1
Oil refrigeration compressors	2	7½

• • •

Use Blended Light in High Bay Area

Blended illumination of 30 ft.-candles from 76 400-watt mercury-vapor and 38 500-watt incandescent lamps is secured in this high bay area of the Armstrong-Blum Manufacturing Company plant, Chicago. The bay is 680 ft. long, 60 ft. wide. Luminaires are mounted in about 18 x 20-ft. centers, 20 ft. above the work area.

The two outside rows of units are mercury vapor, the center row is incandescent and the wattage densities are 1.2 per square foot.



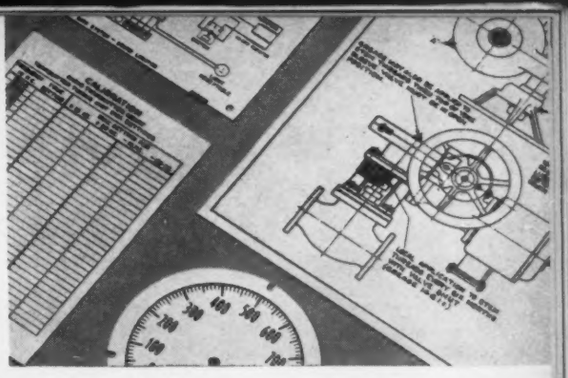
ARCHITECTURE AWARD WINNER — *now busy on Defense!*

DISPLAY CASE and Counter surfaces of Graphic Lamicoid — laminated by Mica Insulator Company for Coty, Inc. — receive the Major Award in the Architecture Division of Modern Plastics 1941 Competition.

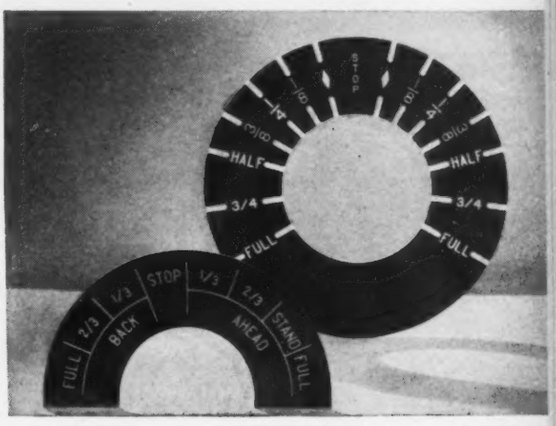
But for the present, the unique advantages of Graphic Lamicoid are being devoted primarily to National Defense. Similarly, other forms of Lamicoid—a few of which are shown—have an essential role in furthering American preparedness. These versatile materials are now used for electrical and mechanical applications—where operation must be unfailing . . . for vital apparatus in all branches of our armed services, as well as in the plants entrusted with the task of equipping them.

MICA INSULATOR COMPANY, 200 Varick Street, NEW YORK — 542 South Dearborn Street, CHICAGO — 1276 West Third Street, CLEVELAND. Representatives in principal industrial centers.

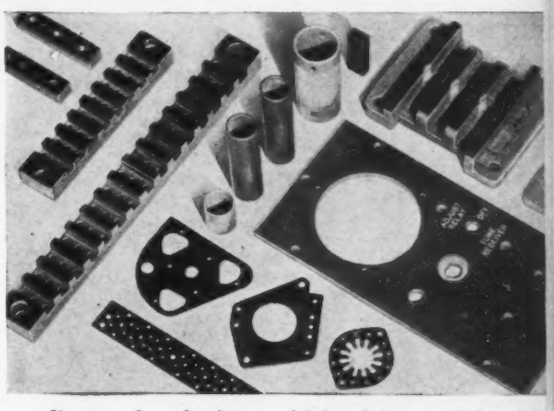
LAMICOID
REG. U. S. PAT. OFF.



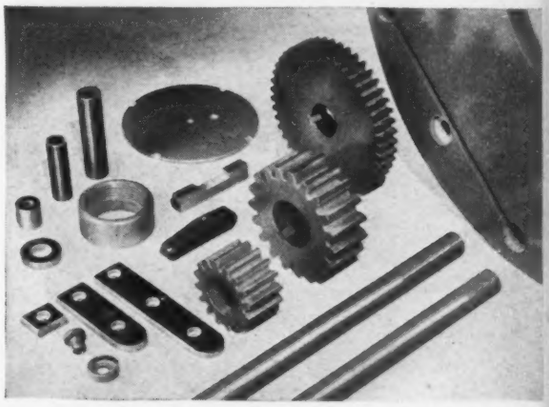
Charts, wiring diagrams, dials, and instruction panels are permanently incorporated into Graphic Lamicoid sheet material and cannot fade, be removed or erased.



Clean-cut, permanent instrument dials and apparatus panels are engraved on a "sandwich" type sheet — exposing either an opaque or translucent (rear-illuminated) core.



Sheets, rods and tubes are fabricated into panel boards, terminals, blocks, coil forms, etc. which combine high dielectric strength with the extreme accuracy of dimensions necessary for radio and electrical work.



Gears, gaskets, bushings and other Lamicoid mechanical or chemical-resistant parts mean longer service and improved operation in a wide variety of Defense applications.

MICA INSULATOR COMPANY

LOAD BUILDING

Merge Sales Divisions To Hold Specialists

Kansas City Power & Light Company merged its two sales divisions recently, erasing the demarkation between major appliance and small appliance salesmen. This action arises from the company's expressed conviction that ability of salesmen to maintain income through major appliance sales alone, during the current period, is remote and that loss of highly trained sales personnel to other fields, as a result, is a possible eventuality.

Officials of the Kansas City utility express the belief that a sufficient commission can be paid on the combined major and small appliance sales of individual salesmen to retain specialists at least until there is a drastic reduction in either credit purchasing or the supply of appliances.

The company does not have a water heating program of any consequence. It is therefore able to improve net revenue more readily with small appliance volume and can consequently afford to pay an increased selling commission, if necessary, on small appliances.

In Kansas City the company reports that the change in credit purchasing terms on September 1 caused major appliance sales to fall off sharply. While the effect of present credit terms may modify in the future as the public becomes accustomed to them, the utility has had to face an increase in price, due to the excise tax, and also recognize the possibility of future tightening of terms, due to governmental action, as well as the widely forecast possibility of additional restrictions on output of electrical appliances.

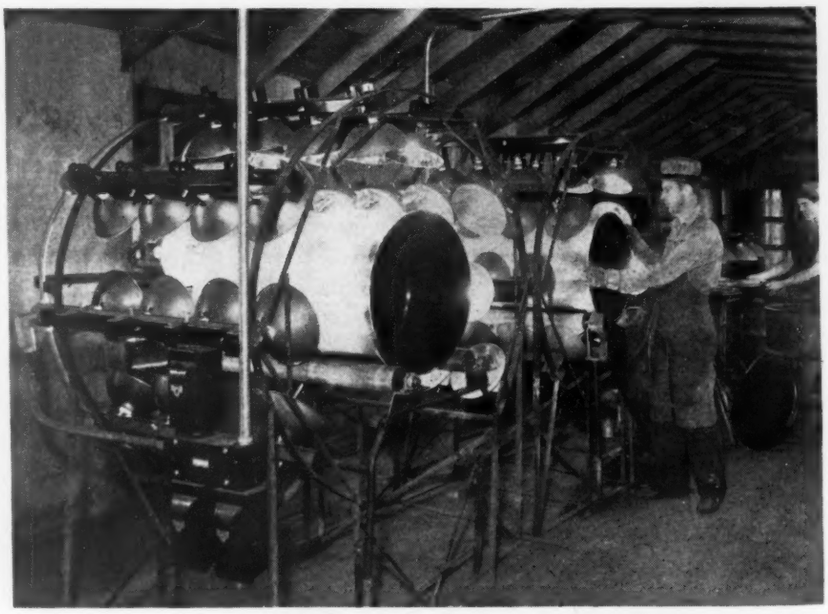
Considering all the factors mentioned above, and the influence of sharply reduced volume on the earning power of major appliance salesmen, the company decided to combine its major and small appliance operations. Its total selling personnel was reduced only about 15 percent, at the time of the consolidation.

Salesmen, under the merger, sell house to house from trucks, operating in six territories, each truck being served by a crew of eight men, a repair man and a supervisor. The repair man is assistant supervisor of the crew. The truck carried complete equipment for the servicing of small appliances. The company is able to justify part of the pay for the salesmen because of volume of appliances brought to the truck for repair.

Steel Barrels Given Resistant Lining

Barrels with non-corrosive, acid-resistant, well-bonded linings are being produced in six minutes, where the former method required sixteen hours at the plant of the Myers Barrel Company, Oakland, Calif. Two 12-kw. Fostoria infra-red baking tunnels are used to dry a sanitary liner on the inside of 55-gal. drums and drumheads that are used for packing lard and other greases. The drums are made of steel.

Each tunnel consists of 44 reflectors with 260-watt carbon lamps. Heat is distributed evenly over the barrel through rotation at 4 r.p.m. Drum-rotating mechanism for both tunnels is driven by a small motor through a



TWO infra-red drying tunnels produce durable lining on rotating steel drums in six minutes, where air drying formerly took sixteen hours. Two small turntables at extreme right bake covers

HERE'S AN IMPORTANT MESSAGE GENERAL ELECTRIC GIVES UTILITY CUSTOMERS!

The following commercial was recently broadcast over the "G-E Mazda Hour of Charm":

"TODAY industry is calling for greater and greater use of eyes—especially those older, more experienced eyes, to work harder and harder, day and night, to aid in this emergency. So isn't it more important now than ever to protect those precious eyes, not only in business, but in the home? Industrial plants are doing much to improve lighting conditions for workers. But when those same workers go home to read or work or play under improper light, the strain is bound to affect their efficiency on the job tomorrow. That's why we say, 'Why not see your G-E bulb dealer tomorrow. He is the one who has that official lamp chart which we call the Anti-Bulbsnatching Chart. This chart shows the correct size bulb for every use in the home. Get a plentiful supply of right-size G-E MAZDA lamps. These lamps that are made to stay brighter longer cost as little as a dime. You can even buy the one hundred watt size for 15c. Remember eye-sight is priceless, light is cheap.' "

This announcement is typical of the Better Light-Better Sight story that the "Hour of Charm" carries every Sunday night at 10 P.M. (E.S.T.—N.B.C. Red Network).

• • • •

P.S. The gentleman at the mike is Richard Stark, one of the announcers on the General Electric MAZDA *Hour of Charm, featuring Phil Spitalny's famous All-Girl Orchestra.*

G-E MAZDA LAMPS

GENERAL ELECTRIC

speed reducer and a series of belts and pulleys. The same mechanism also drives the two vertical turntables used for baking drumheads. Four reflectors and four lamps bake the special enamel on the drumheads.

Prior to using infra-red heat it took sixteen hours to air dry the drums and then the quality of lining was not perfect due to non-uniform drying. Also the lacquer nearest the metal was frequently soft. With the new method a hard, non-porous surface is produced.

The installation was made by the Pacific Electric Motor Company, following a trial job which convinced the owner of the plant of the advantages of the method.

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Flat-Rate Floodlights Earn $155 per Kw.

"Dusk-till-Dawn" floodlighting on a flat rate has grown in favor on the Blackstone Valley Gas & Electric system in Pawtucket and vicinity to a point where 70 company installations are now in service, representing an energy use of 184,000 kw.-hr. per year, a connected load of 46 kw. and an annual revenue of $7,115, according to a paper before the recent regional meeting of the I.E.S. in Hartford, Conn., by Walter L. Kelley, Jr., of the Rhode Island utility. The basic features of this plan were described by Messrs. Kelley and Manchester in ELECTRICAL WORLD July 29, 1939, page 56. The service consists of a dusk-to-dawn floodlight application at a yearly rental of $15, payable in advance with the order, plus a monthly charge of $4.92 for the 300-watt size, $6.72 for the 500-watt and $11.64 for the 1,000-watt unit. This gives a total daily cost respectively of 20, 26 and 42 cents.

These monthly charges are the company's regularly filed private street lighting rate, which is the municipal rate plus 20 percent, and the $15 a year pays off the original cost of the equipment installation in about five years, so there is a satisfactory profit to the power company in the plan, combined with the simplest possible co-operation on the part of the customer, be he a garage operator, merchant or industrial plant manager.

No "gadgets" or physical labor on the part of the salesman are required.

"Copper Kettles of Light" rent for 20 cents per day up in Rhode Island territory of Blackstone Valley Gas & Electric Company

All the salesman has to do is to call on the prospect, generally by request; measure two angles with a sheet of paper and a pencil, pace off the distance and collect the advance payment, then turn over the data to the line department for mounting the lamp properly on the nearest pole, fitted with the proper lens to give the desired beam pattern. Energy is obtained from series street circuits through a small series-multiple transformer or directly from the multiple secondary lines through time-clock control. For each installation the company makes, two or three more are made by electrical contractors.

Modern Front for Utility Offices

An artistic combination of colored fluorescent light and modern architectural glass has given Indiana Service Corporation a strikingly effective front for its principal commercial office in Fort Wayne, which company executives believe will prove valuable in promoting commercial display lighting in Fort Wayne's business district.

Connected load in the sign is 3,094 watts, which gives an estimated brightness of 250 to 300 lamberts. Operating cost is about $0.06 per hour.

Main panel of the front is of Libby-Owens-Ford Vitrolux glass. Side columns are cast fluted sections of Corning glass with a satin etch finish on the back.

Lighting is solely by means of fluorescent lamps. Twenty- and thirty-watt lamps have been used to permit changes of color. There are seven continuous rows of lamps across the front, spaced on 9-in. centers. Each vertical column houses two rows of lamps.

At present the side columns are lighted with blue lamps to tie in with the blue side walls in the office. White lamps are used elsewhere.

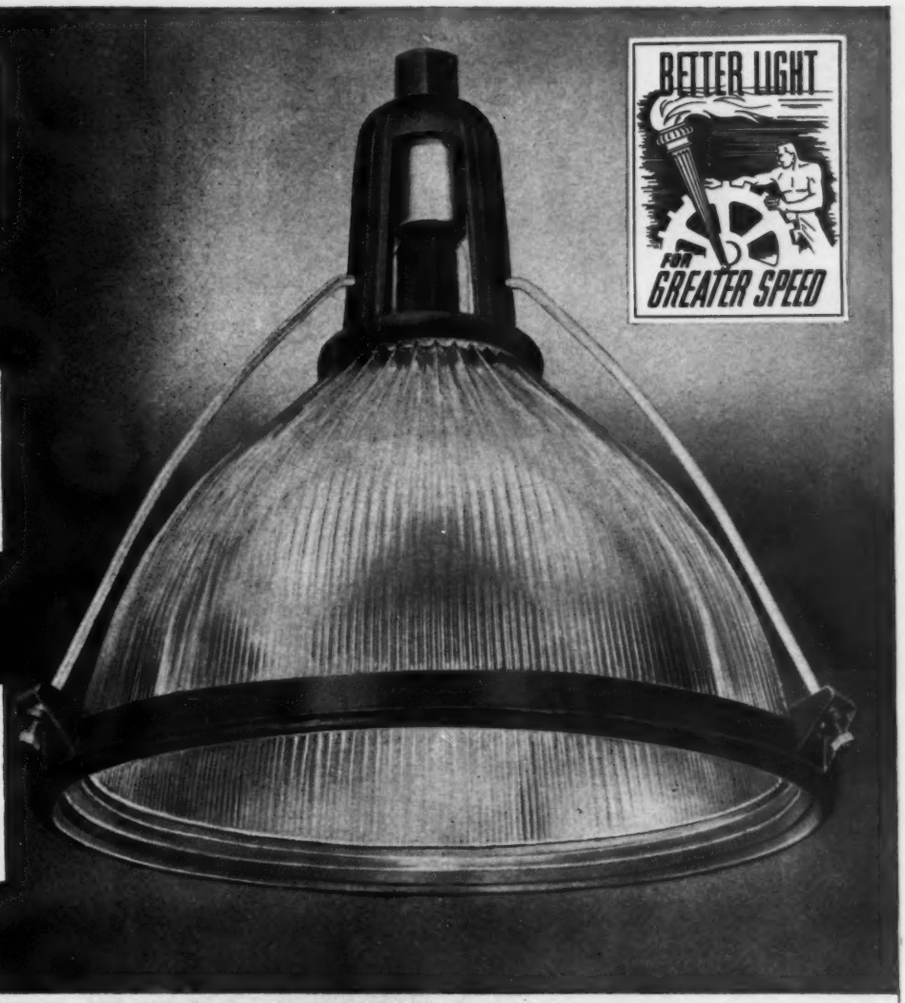
The Vitrolux panel is buff with the porcelain enamel top in maroon. Silhouette lettering is bronze. The cost of the installation was about $4,500.

WITH THIS MODERN FRONT, using architectural glass and colored light, Indiana Service Corporation has "set the pace" for Fort Wayne merchants. With a connected load of 3,094 watts, the brightness is between 250 and 300 lamberts

NEW
Built for Today

READY
No Critical Materials

RIGHT
for Efficiency Permanence, Safety



HOLOPHANE HIBAY REFLECTOR (500-1500 WATTS)

Today, Planned Lighting does its part in the fight for greater speed. With eyes working harder, working longer and under nervous tension, this new Holophane Unit is a timely aid to defense. It accelerates production schedules and reduces costly errors.

The Holophane Hibay Unit No. 990, illustrated here, is one of four new reflectors each with a different light distribution for uniform results under varying mounting conditions. The fact that these reflectors were designed and produced within the restrictions of the emergency is a tribute to Holophane research and engineering skill.

- **INVESTIGATE** *how conservation of materials, of power and of men can be advanced in your plant by the installation of new Holophane Hibay Reflectors. Write for details. No obligation.*

STUDY THESE ADVANTAGES:

1. Uses no critical defense materials
2. Standard Holophane construction . . . sturdy as a Cranelite.
3. Traditional Holophane efficiency, permanence, safety
4. No wattage limitations—maximum 1500 watt Incandescent or 400 watt Mercury
5. Common-sense high bay light distribution for high mounting

LOWER COST—FASTER SHIPMENT

Holophane
COMPANY, INC.
342 MADISON AVE.
NEW YORK CITY

Lighting Authorities—Since 1898
THE HOLOPHANE CO. LTD.
[illegible] Yonge St. Toronto, Canada

NEW ENGINEERING IDEAS

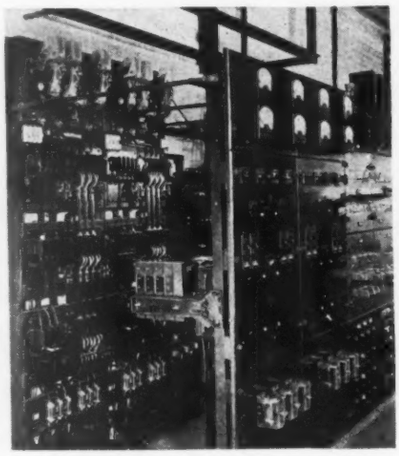
Sine Wave Test Set Is Flexible

A highly versatile sine wave motor-generator set has recently been installed in the electrical engineering laboratories of the Worcester Polytechnic Institute, with permanent control board of the dead-front type. The set consists of four machines in line on a common axis with a 17½-ft. base with three Fast disconnecting type couplings. At the outer ends are two 75-hp. d.c. machines, the inside pair being 75-kva. synchronous machines.

Both a.c. machines are of the non-salient pole, distributed winding, revolving field type, giving a sine wave whose largest harmonic is 0.001 of the fundamental. One machine stator may be shifted (while running) through 360 deg. with respect to the other machine to permit artificial loading back of the two synchronous machines, or the variation of power angle or other quantities. Frequency may be varied from 15 to 75 cycles per second and the machines are rated at 220/440 volts with separate excitation. Both machines have amortisseur windings, permitting induction motor action in starting and providing good damping.

The d.c. machines are provided with compound windings for both motor and generator operation, with the option of selecting shunt, partial or full compound running. Ratings are 115 volts, 60 kw. or 75 hp. and the machines can be driven from each other for Ward-Leonard speed control.

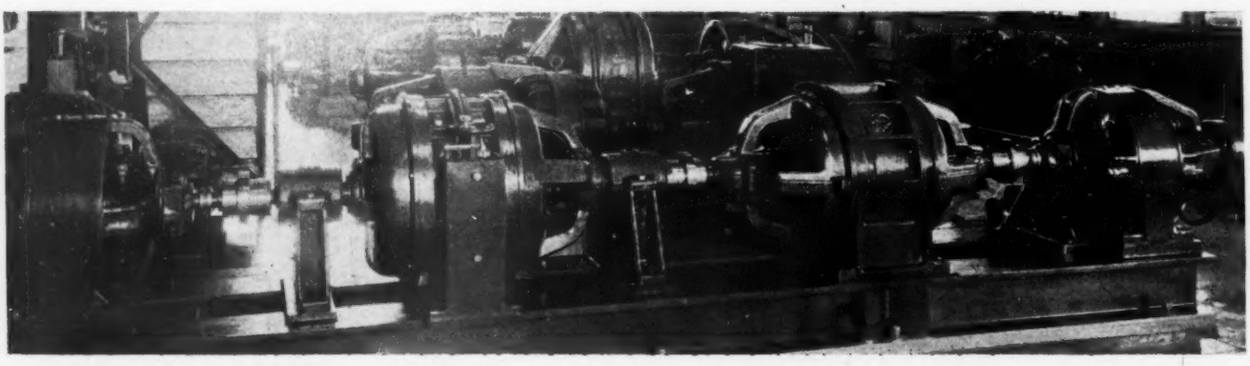
All a.c. coil connections are carried over to a nearby switchboard where series-parallel switching is used to provide a wide voltage range and also permits a half-voltage (220-volt) starting. A double-throw bus selector switch enables the a.c. portion of set to be run off either of two 220-volt buses. Field switches select from two exciting sources, with motor operation of rheostat drives by remote push-button control.



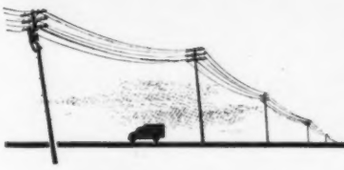
DEAD-FRONT industrial type control board with wall relay rack for sine wave set

These a.c. panels are duplicates, one for each machine. Full protection is afforded by line instantaneous overcurrent relays and by heat links in each coil circuit of the machine. Over-voltage relays also prevent accidentally exceeding normal line voltages. Pilot lamps indicate all relay and contactor operations, field current supply and bus voltages. A novel feature of the switchboard-machine combination is its ability to start as a motor with reduced voltage characteristics simply by the rearrangement of machine connections. Coil connections for series or parallel operation are made up by 100-amp. relays set in proper sequence, while a 300-amp. main contactor connects the machine to the 220-volt bus.

For starting, the selector switch is turned to the start position, locking the relays in series (equivalent to a



MULTI-PURPOSE motor-generator set facilitates testing, experimental work and instruction



Quality First

WHEN you order an American line construction or service body, you can be sure that it will be the best suited to its purpose, the finest designed and most sturdily built that scientific engineering and modern manufacturing processes can devise.

From the day it starts operating it will begin to pay big dividends—in lower operating costs, in greater convenience, in better arrangement of spaces for carrying materials and not least, in the maximum of comfort and safety for the crew. Still other advantages can be cited such as finer appearance, lower upkeep, and so on.

America's policy has always been to build to the highest standard of quality, with price ever a secondary consideration. But invariably, utilities find that in the long run American bodies are by far the least expensive they can buy.

WRITE FOR LITERATURE

A&B

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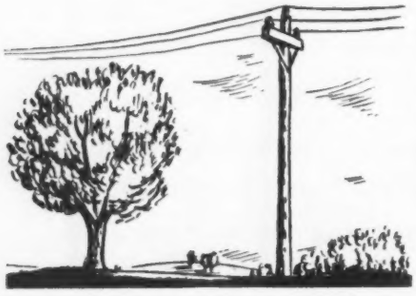
MANUFACTURER OF STANDARD EQUIPMENT FOR PUBLIC UTILITIES

At the "End of the Line"

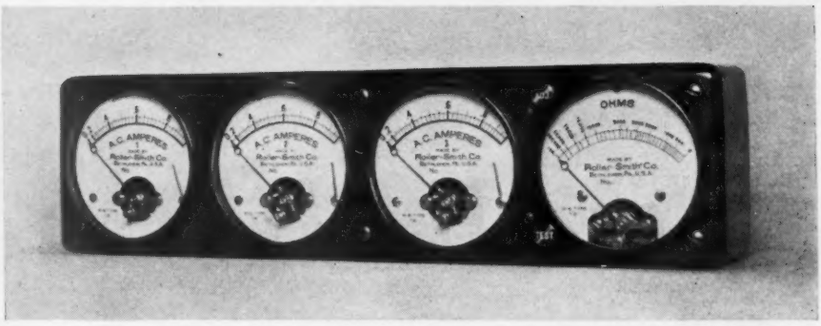
Men are at work—millions of them—at the "end" of every power line. The great majority of them are on jobs vital to our defense—work that must not be interrupted by power failures. . . . You can avoid a frequent source of outage by putting it up to Asplundh to keep your lines always free and clear of tree trouble. . . . One of our several different contracts is sure to meet your requirements and budget.

Write for them today



ASPLUNDH
TREE EXPERT COMPANY
Jenkintown, Pennsylvania
Ogontz 3750

Chicago, Ill.	Baltimore, Md.
Binghamton, N. Y.	Durham, N. C.
Columbus, Ohio	Rutherford, N. J.
Cambridge, Mass.	New Castle, Pa.
Alexandria, Va.	Pittsburgh, Pa.
Washington, D. C.	Omaha, Nebr.



TRIO of ammeters and an ohmmeter detect secondary defects in differential protective circuits. Ammeters are 1 amp. Ohmmeter consists of d.c. microammeter and 22½-volt dry battery. Each instrument may be rotated 90 deg. for permanent vertical mounting on switchboard

440-volt connection), which energizes the coil circuit of the main contactor. At synchronous speed field excitation is supplied and the motor pulls into step, after which the selector switch is turned to the run position. Sequencing interlocks require the main contactor to drop out; the relay shift from series to parallel, and the main contactor recloses, all automatically and in rapid fire order. The failure of a sequencing relay to engage or other mishap merely locks out the main contactor and requires restarting. Any overcurrent rush operating the instantaneous relays opens the line contactor, while the heat link (time) relays remove the field as well.

•

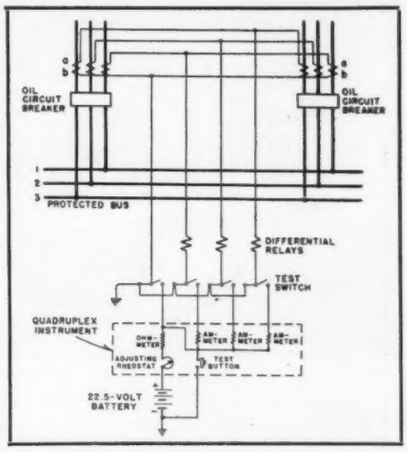
Quadruplex Checks Differential Relays

J. H. KINGHORN
American Gas & Electric Service Corporation, New York

Secondary circuit troubles in differential relay circuits have been detected by a combination of three ammeters and an ohmmeter and incorrect differential operations materially reduced.

The most common faulty operation has been due to accidental open or short in the secondary circuit or to secondary insulation failure. Such defects usually afford ample opportunity to correct the condition before system fault current beyond the differential-protected equipment would cause faulty tripping at this location.

The instrument assembly is a four-element device comprising three 1-amp a.c. ammeters and a 1-megohm ohmmeter. Three ammeters permit simultaneous measure of current in the operating coils of each phase differential relay. The ohmmeter determines the resistance to ground of the secondary circuit insulation.



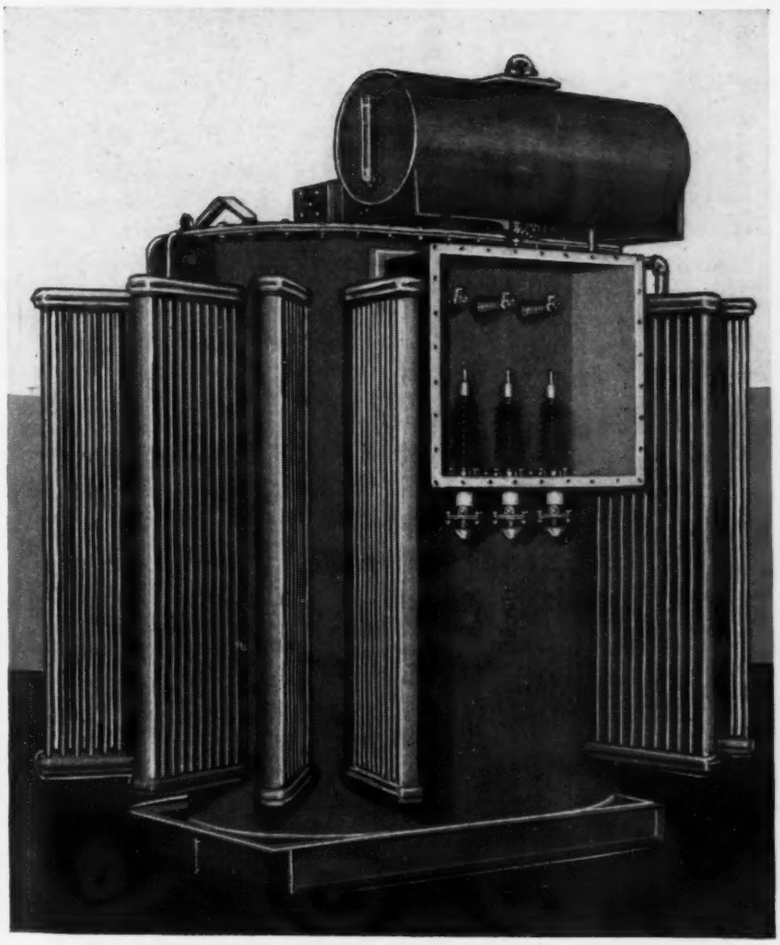
DIFFERENTIAL relay circuit defects ferreted out

Permanent ground removed and four instruments connected in by the isolating test switch. Several differential circuits may be tested by a single quadruplex installation. Test switch key removable only in "Off" position. Progressive insulation deterioration revealed by comparison of periodic ohmmeter readings. Ohmmeter provided with short-circuiting push button and rheostat to calibrate for departure in battery voltage.

By observing all three phases simultaneously the normal small amount of unbalance (particularly in transformer protection) may be observed and discounted. Any further unbalance indicates something wrong unless it is known also that the load currents are unbalanced. Open circuits in current transformers will give large secondary unbalances and here the three ammeters are particularly helpful.

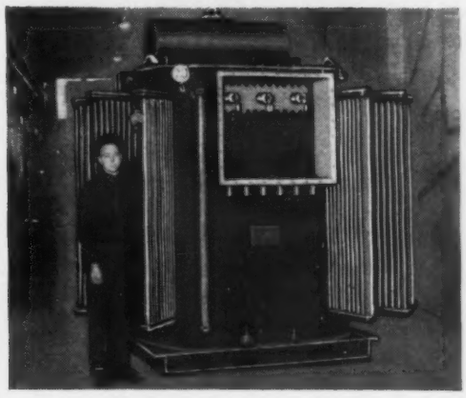
Each differential circuit at attended stations checked every shift by the operator. At unattended stations the tests are part of the regular periodic inspection routine. At any indication

UPTEGRAFF *Power* TRANSFORMERS



Geared in accordance with today's defense program, we are producing at a rate many times our normal of former years. Yet every Uptegraff Transformer is individually designed, individually built, individually certified for performance. You can depend on Uptegraff "Quality and Service."

"Designed and built for special requirements" means that the Uptegraff organization is splendidly equipped in engineering ability and in shop facilities to take care of unusual Transformer needs. Write us.



Designed and built in complete accordance with American Institute of Electrical Engineers (AIEE), and National Electrical Manufacturers Association (NEMA), also American Standards Association (ASA). "Quality and Service" in fact and in name.

R. E. UPTEGRAFF *Manufacturing Co.*

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VULCOID

HERE MAY BE THE ANSWER TO YOUR "WHAT MATERIAL?" PROBLEM

CAUTION should be used in selecting substitute materials ... such as plastics for metals ... to make certain that shortages will not also develop in the substitute selected.

VULCOID is a NON-metallic ... a laminated plastic fibre made in sheets, rods and tubes ... readily fabricated on standard metal working machinery. It is tough ... moisture resistant ... heat resistant and oil resistant. It has high electrical insulating properties and is exceptionally resistant to carbon deposits from electrical arcs. VULCOID is approved by the Underwriters' Laboratory for the insulation of current carrying parts.

VULCOID is a product of Continental-Diamond Laboratory research. Its development has progressed over a number of years. *Its availability at this time is especially opportune because in its production it requires considerably less of present hard-to-get raw materials than do many other NON-metallic products.*

Properties of VULCOID

¼" THICK MATERIAL

Specific gravity 1.35
Tensile Strength 7,000/11,000 PSI
Flexural Strength 16,000/20,000 PSI
Shearing Strength 10,000/12,000 PSI
Compression Strength 36,000 PSI
Moisture absorption 4% to 8%.
(% weight gain in 24 hours immersion)
Dielectric Strength 250/350 volts per mil.

VULCOID may be the answer to your "What Material?" problem. Let us send you Technical Data Bulletin BC-12.

Continental-Diamond FIBRE COMPANY

Established 1895 . . . . Manufacturers of laminated plastics since 1911

NEWARK • DELAWARE

of trouble the relays are immediately removed from service and report made to the system relay engineer.

•

Nomogram Computes Parallel Circuits

By B. E. ELLSWORTH
Electrical Engineer
Iowa-Nebraska Light & Power Company
Lincoln, Neb.

The job of computing parallel circuits often becomes long and tedious when repeated a number of times. The accompanying nomogram, when drawn on graph paper, will give the answers by merely placing a straight edge to connect the values involved. Any formula of the form

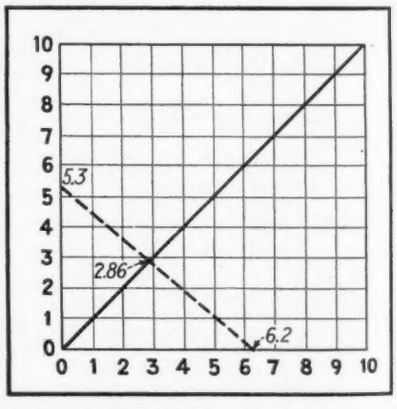
$$\frac{1}{Z_T} = \frac{1}{Z_1} + \frac{1}{Z_2}$$

Or

$$Z_T = \frac{Z_1 Z_2}{Z_1 + Z_2}$$

may be solved graphically by this method. A very simple relation of similar triangles proves its correctness.

A 45-deg. line is drawn on graph paper and the abscissa and ordinate are laid off to any desired scale. The scales may represent impedances, reactances or resistances. By placing a straight edge between the values used the answer is found at the point where



SIMPLE NOMOGRAM yields total impedance of parallel circuits

Best accuracy for values not too different in magnitude. Extend one scale if quantities are unequal in whole numbers.

the straight edge crosses the 45-deg. line. Value can be read on either scale. As an example, 6.2 and 5.3 ohms are parallel and the answer is 2.86. Obviously if 62 and 53 ohms are paralleled the answer will be 28.6. Any degree of accuracy may be secured, depending upon the size of paper used for the nomogram.

The BEST PROOF is Performance

HERE is a typical example of the service performed by . . .

SIMPLEX PAPER INSULATED CABLES

Approximately ½ actual size.

Back in 1930 we made the cable illustrated for a public utility company in New York. It has a 1″ rope core and 658 strands of copper, totaling 4,000,000 C.M. The insulation is for 15,000 V.W.P. Up to that time it was the largest paper cable made. It weighed 24.2 pounds per foot and had an outside diameter of 3.61″. Since it was installed it has been in constant operation and has given very satisfactory service.

Simplex paper insulated cables are made to give years of uninterrupted service. Data Sheet #109 — June, 1941 — which tells more about them will be sent upon request.

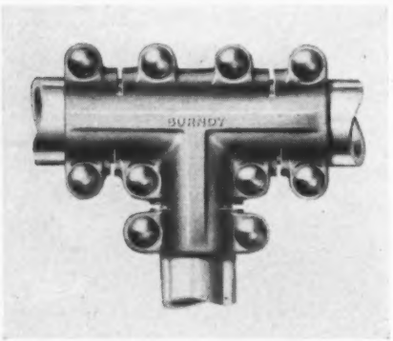
Simplex Wire & Cable Co., 79 Sidney Street, Cambridge, Mass.

SIMPLEX WIRES CABLES

NEWS OF THE WEEK

T-Connector

High copper alloy multigrip type T-connector for tubing combines the function of T-connector and coupler at a single



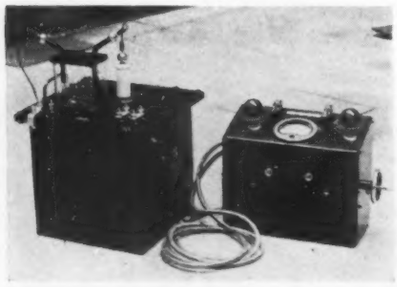
Type "NST" T-connector; sizes to accommodate from ⅜-in. IPS to 6-in. IPS on either run or tap. **Burndy Engineering Co., Inc.,** 459 East 133d St., New York, N. Y.

point. It is slotted between Everdur oval-shank bolts to provide independent high-pressure areas of contact and is finished to provide minimum contact resistance. Aluminum and aluminum-to-copper combinations are available.

•

Testing Set

Portable high-voltage testing set used chiefly for breakdown tests on oil and other insulating materials is available now in two units, viz., control panel and regulator in one case and step-up transformer in another case. Weight is approximately one-third less than former single-unit equipment.



Portable high-voltage testing set; ratings 35 and 50 kv. **Ferranti Electric, Inc.,** 30 Rockefeller Plaza, New York, N. Y.

Fluorescent Fixture

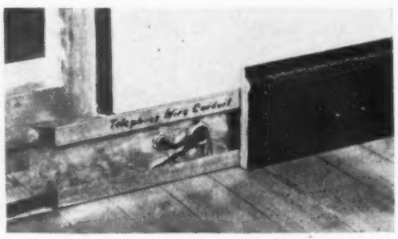
"Three-Forty" fluorescent industrial fixture; accommodates three 48-in., 40-watt fluorescent lamps. **Day Brite Lighting, Inc.,** St. Louis, Mo.

New fixture has porcelain enamel reflector made in one piece. Hood and reflector are finished in gray. Hinged top can be swung open for parts replacement or for making wire connections. Unit is available for either chain or pipe suspension, but hangers are not included.

•

Conduit Base

Providing concealed yet accessible current and telephone wires, conduit base can be erected on the job. Additional outlets and telephone connections can be made without "fishing" in walls for wire. Base boards are removable; closures may be wood, steel, tile, etc.



Type "E-L-C" (Erecto-Luxtite-Conduit) base; types available for erecting in front as well as under the plaster. **Charles E. Barnes & Son,** 4320 Osage Ave., Philadelphia, Pa.

•

Plating Anode

Mop style plating anode. **W. A. Hesse & Co.,** 1015 Santa Clara Ave., Alameda, Calif.

New plating anode is said to be faster in depositing metal such as silver and displaces the former plating brush for use on irregular surfaces. It is used in connection with the company's portable kit for electroplating current carrying parts such as switch contacts, busbars, fuse clips, cable ends and clamps.

BUYING ELECTRICAL EQUIPMENT?—McGraw-Hill's *Electrical Buyers Reference* is a convenient place to look first for manufacturers' product data, names and addresses.

Cable Reel

New adjustable cable reel permits wire to be pulled off in a smooth, even flow, it is claimed. It expands to a snug fit against

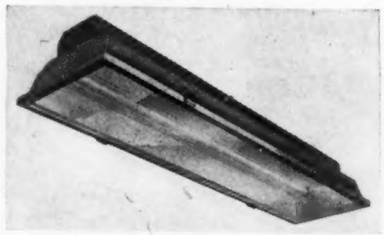
Adjustable cable reel. **Line Material Co.,** Milwaukee, Wis.

the inside of the coil and has breaking action to prevent the reel from continuing to turn after the lineman has stopped pulling the wire. The reel swings on a hinge in a full 90-deg. arc from the rear of the truck; may be used to reel in old wire.

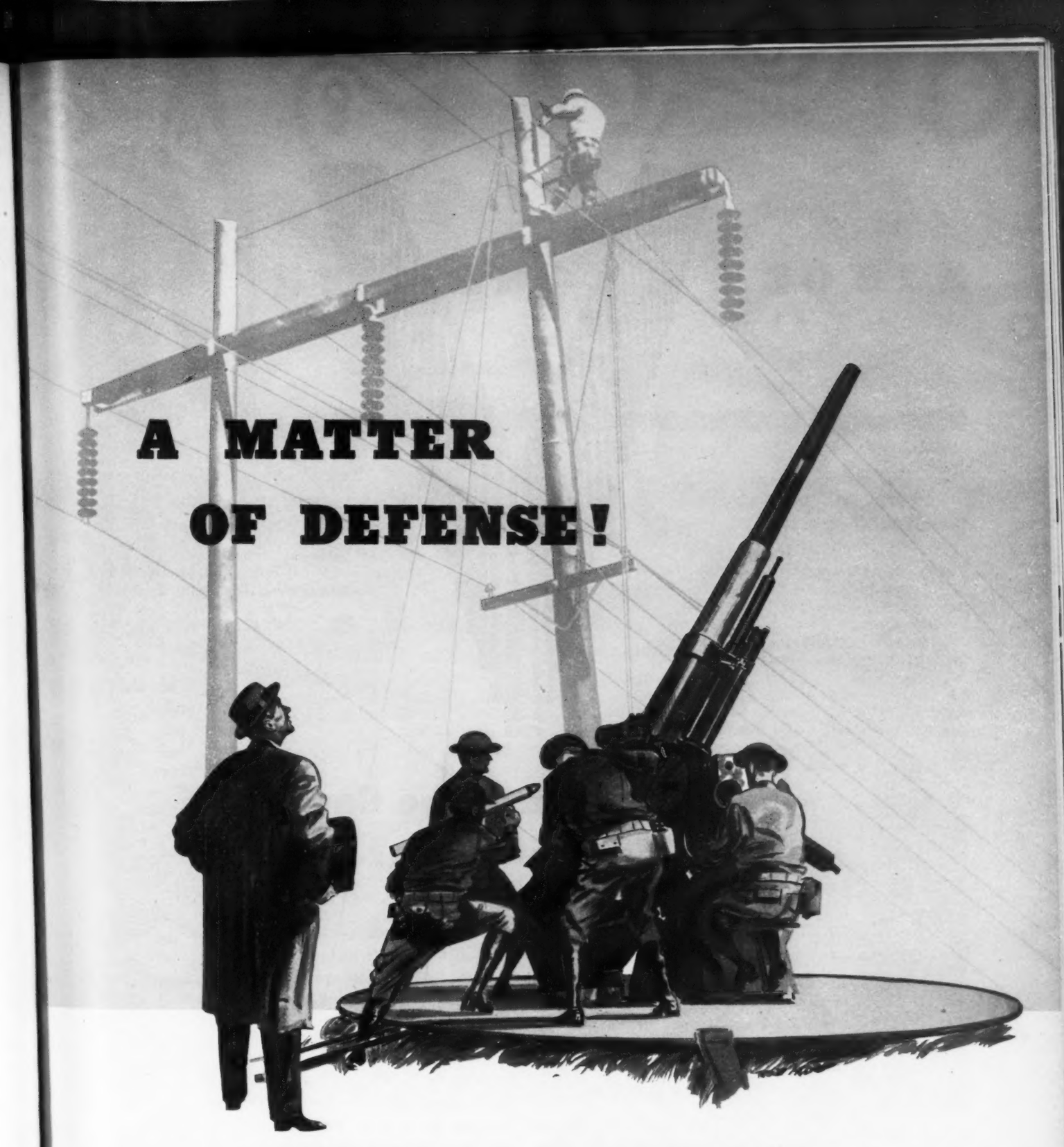
•

Fluorescent Luminaire

Extended light lines may be constructed by four types of a newly designed 40-watt fluorescent luminaire. Channels provide a continuous wireway which may be mounted on conduit, messenger cable, twin-rod suspension or directly on the ceiling. Units have twin-ballasts with built-in compensators providing power factor of 90 percent or over. Diffused lighting of intensities from 30 to 100 ft.-candles is said to be provided with ordinary spacing and mounting heights.



Type "FPS-40" fluorescent luminaire; uses two or three 40-watt lamps. **Westinghouse Elec. & Mfg. Co.,** East Pittsburgh, Pa.



Every mile of Pole Line that YOU build is a matter of defense effort. Every watt that flows through your conductors is a contributing factor toward the production of a bomber, a battleship or a field-piece.

These instruments of warfare cannot be produced without power—and power cannot be utilized without electrical transmission and distribution systems built to defy the naturally destructive elements of corrosion, electrical strain from lightning and mechanical strain from wind and sleet.

Whether it is a matter of defense or just good, plain, everyday customer service, it has to be RELIABLE. The engineer who specifies Hubbard Pole Line Hardware for his lines is giving his customers that quality which is an assurance of reliability.

ANG THE DEFENSE LOAD ON HUBBARD HARDWARE!"

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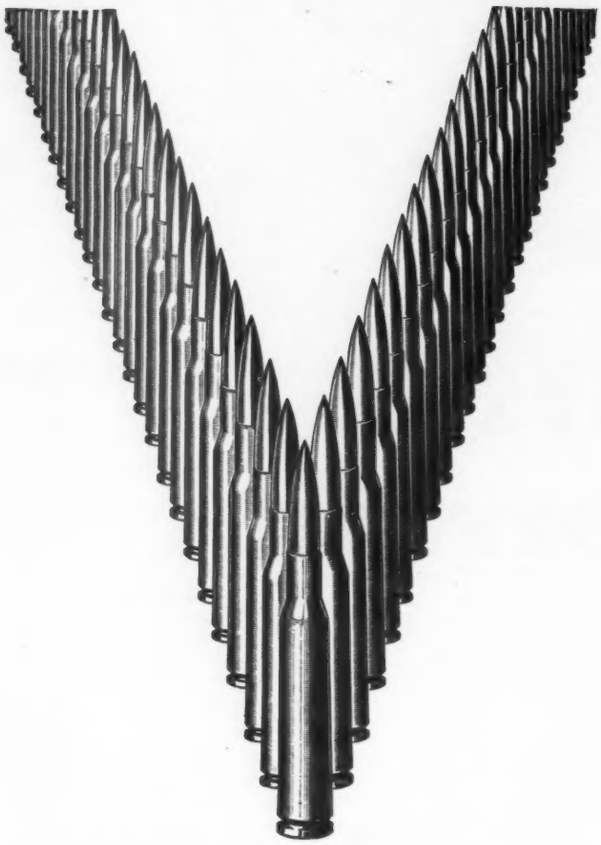
PITTSBURGH, PENNSYLVANIA
CHICAGO, ILLINOIS
OAKLAND, CALIF.

HUBBARD



Why are Cartridge Cases Made of Brass?

BRASS possesses the ductility and malleability to withstand the extensive drawing and forming operations necessary to high speed production of cartridge cases on automatic machines. Important, too, is the fact that Brass is extremely resistant to corrosion—permitting storage of ammunition for extended periods under all climatic conditions.

"Cartridge Brass"—70% copper, 30% zinc—has inherent properties which not only allow the case, under firing pressure, to expand to the walls of the gun chamber without cracking or splitting, but also to contract for quick extraction. From the .30 caliber rifle cartridge to the six inch shell, brass in large quantities is doing a fundamental defense job that no other metal can do as well.

Brass, Copper and Bronze are indispensable to nearly every phase of the National Defense Program. The Number One task of the entire Anaconda organization is therefore to devote every effort to the on-time delivery of the tremendous quantities of our metals required by the emergency.

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Subsidiary of Anaconda Copper Mining Company • In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

NEWS ABOUT PEOPLE

T. I. Phillips Assumes New Executive Duties

T. I. Phillips, who was appointed last February as assistant to the president of the Westinghouse Electric & Manufacturing Co., has been elected a vice-president of the company.

Mr. Phillips joined Westinghouse in 1915, and in 1935, after serving as manager of works departments in several plants, he was appointed general works manager to serve as central authority for all manufacturing operations of the company.

•

▶ JOSEPH W. ALSOP, a member of the Connecticut Public Utilities Commission, has been elected president of the Hartford County Mutual Fire Insurance Co., succeeding the late F. F. Small. Mr. Alsop will continue as a commissioner.

▶ C. MELVIN SHARPE, executive assistant to the president of the Potomac Electric Power Co., Washington, D. C., has been designated by Commissioner John R. Young, civilian defense coordinator for the national capital area, as chief of utilities in the defense setup. Mr. Sharpe will be the executive for civilian defense under Col. Lemuel Bolles, district civilian defense director, and Commissioner Young.

•

Stone & Webster Makes Staff Promotions

Seventeen engineers on the staff of the Stone & Webster Engineering Corp., Boston, have been given higher ratings in five divisions, including the electrical, industrial, mechanical, petroleum and structural branches of the organization. Samuel P. Melville, Charles W. Maloney, Algodt J. Seaburg and Eric A. Stroberg have been designated as electrical engineers; Chester W. Welch and Charles A. Whittemore, industrial engineers; Alton A. Kirkpatrick, Burton C. Mallory, James A. Powell, Charles R. Stewart and Alden D. White, mechanical engineers. The others advanced are H. S. Houghton, R. J. Carter, A. W. Pratt, E. E. Bigelow, R. D. Chellis and L. Kerr.

•

▶ PROF. GEORGE F. CORCORAN has been appointed chairman of the department of electrical engineering at the University of Maryland, College Park, Md. Professor Corcoran was formerly connected with the University of Iowa and previous to that connection he taught at Kansas State College and at the University of Minnesota.

▶ WILLIAM H. SULLIVAN, steam engineer for the Westinghouse Electric & Manufacturing Co. at Philadelphia, Pa., for the past five years, has been named steam engineer for the company's Pacific Coast district with headquarters in San Francisco. In his new position Mr. Sullivan will be active in all negotiations involving steam turbines for land and marine uses. His territory as a consultant will comprise the entire Pacific Coast territory of the company.

W. H. Milton, Jr., Heads Plastics Department

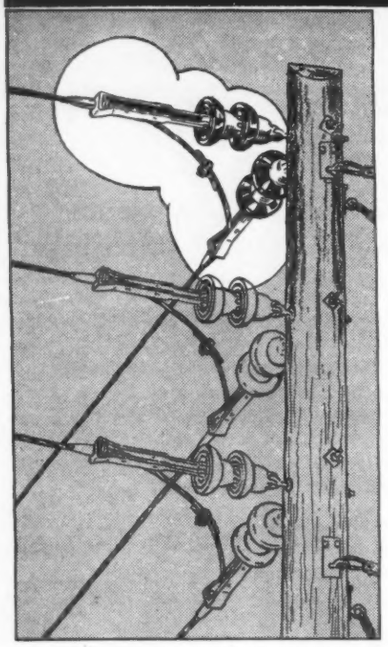
William H. Milton, Jr., has been named manager of the plastics department of the General Electric Co., Pittsfield, Mass., succeeding G. H. Shill, who becomes assistant to the manager of the appliance and merchandise department with headquarters in Bridgeport, Conn. Mr. Milton will have the responsibility for the operation of the company's five plastics factories in Pittsfield, Taunton and Lynn, Mass.; Fort Wayne, Ind., and Meriden, Conn.

Mr. Milton joined the plastics department in 1938, transferring from the company's Philadelphia plant, where he was a specialist in the power and mining department. In 1940 he was named assistant manager of the plastics department.

•

▶ FRANK W. ROWE, general purchasing agent of Johns-Manville Corp., for 23 years, has retired. Mr. Rowe joined Johns-Manville in 1914 after serving as a purchasing agent for the General Electric Co. In 1937 he relinquished his position as general purchasing agent for reasons of health and became purchas-

modernize
YOUR
DISTRIBUTION
PRACTICE—



RELIABLE
STRAIGHTLINE
DEADENDS

Reliable Straight-line Deadends with extra long rigid clevises offer plenty of clearance from skirts of large disc insulators on turns. An extra hole in the clevis accommodates a pin and sling to permit easy and accurate sagging of line.

Reliable
ELECTRIC COMPANY
OVER 30 YEARS SERVICE TO THE UTILITIES
3143 CARROLL AVENUE · CHICAGO ILLINOIS

ing consultant for the company. Mr. Rowe was an organizer of the Purchasing Agents Association of New York and a regional vice-president of the National Association of Purchasing Agents.

▶ E. W. SMITH, formerly manager for Florida Power & Light Co., at Cocoa, Fla., has been transferred to Fort Myers to take charge of that district. He is succeeding the late Grover Gerald. Mr. Smith is rounding out fifteen years of service with Florida Power & Light.

▶ W. J. THOMAS, who has spent nine years with the process equipment division of the Babcock & Wilcox Co. at Barberton, Ohio, has been transferred to the executive department of the sales offices of Babcock & Wilcox Tube Co., Beaver Falls, Pa.

▶ E. A. BRAND, Buffalo Niagara & Eastern Power Corp., Buffalo, N. Y., has resigned as chairman of the Industry Committee on Interior Wiring Design because of the pressure of company work and of other committee activities. ALLAN COGGESHALL, Hatzel & Buehler, Inc., engineers and contractors of New York, who has been vice-chairman of the committee, will succeed Mr. Brand as chairman. Mr. Coggeshall has devoted his entire career to studying the problem of wiring costs from its engineering, economic and social standpoint.

▶ ROBERT PAXTON has been appointed manager of the General Electric Co.'s Philadelphia works. He had been assistant to the late Philadelphia works manager, R. V. Good, for the past year. Mr. Paxton has been with General Electric since 1923, when he entered the company's test course at Schenectady following graduation from Rensselaer Polytechnic Institute. He was assigned to the switchboard department the following year. In 1927 he went to the Philadelphia works as the first oil circuit breaker engineer, and was promoted to managing engineer of the metal-inclosed division in 1930. Following the consolidation of this division with the manual and automatic panel sections in 1932, Mr. Paxton became managing engineer of the panel and equipment division, serving in that capacity until his appointment as assistant to the works manager last year.

▶ R. H. RASCHKE, manager of the Winnebago district, Interstate Power Co., has recently been appointed to succeed JOSEPH WUERTH as manager of the company's Decorah district. Mr. Wuerth recently resigned after fifteen years of service with the company. G. C. YOUNG, power sales engineer of the Albert Lea district, has been appointed to succeed Mr. Raschke.

L. A. WILLIAMS, who recently became executive assistant to Frank McLaughlin, president Puget Sound Power & Light Co.

▶ JOHN H. MCKENNA has been appointed to the executive staff of Pierce Laboratory, Inc., New York. Mr. McKenna has been associated with Knapp-Monarch Co., St. Louis, Mo., in the capacity of national utility sales manager. Prior to this connection he was associated in an executive sales capacity with the A. J. Lindemann & Hoverson Co., Milwaukee; Kimball Electric Co., New York City, and the Hurley Machine division of Electric Household Utilities Co., Chicago. Mr. McKenna is the president of the Electrical and Gas Association of New York. In his new position he will maintain contact with all the defense industries.

▶ EDWARD J. CRUMMEY has been elected secretary of the Long Island Lighting Co., succeeding Henry R. Frost, who retired recently, having reached the age limit provided in the company's retirement annuity plan. The secretaryship is not a new experience for Mr. Crummey as he served in this capacity for a period of approximately three years between the early part of 1935 until 1938. Since 1938 Mr. Crummey has been principal attorney of the Long Island Lighting System Companies and he will continue his connection in the law department in that capacity. Simultaneous with his re-election to the position of secretary of the Long Island Lighting Co., Mr. Crummey was also elected secretary of the Queens Borough Gas & Electric Co., Nassau & Suffolk Lighting Co. and the Long Beach Gas Co. Mr. Frost, the retiring secretary, was elected the first secretary of the company in 1911 and was also appointed its attorney. In 1919 he was appointed assistant general manager. He served continuously as secretary until 1935 and on January 1, 1938, he again filled the office until his retirement last September.

OBITUARY

▶ LOUIS SEEL, president of the Belton Light, Heat & Power Co., Belton, S. C., died November 4 in Charleston, S. C. Mr. Seel was 54 years old.

▶ CLARENCE G. IVES, general superintendent of the Acme Wire Co., New Haven, Conn., died on September 17 in that city, following an illness of several months. Mr. Ives served the company for 33 years and had been superintendent since 1930.

▶ HARRY K. PATTERSON, assistant superintendent of the northern division of the Connecticut River Power Co., Littleton, N. H., died November 10 at the Hanover (N. H.) Hospital, after a brief illness. He was born on December 25, 1890, in Newburgh, N. Y.

▶ JAMES K. NEILL, assistant superintendent of construction for the Portland General Electric Co., Portland, Ore., died suddenly at his home in that city on November 6. Born in La Grande, Ore., 53 years ago, Mr. Neill was graduated from the University of Oregon in 1910 and had been employed by the electric company for more than 30 years.

▶ AUGUST V. R. COE, formerly secretary and assistant treasurer of the Philadelphia Electric Co., died on November 20, of a heart ailment, at the Warwick Hotel in Philadelphia, where he made his home. He was 76 years old. Mr. Coe was made secretary and assistant treasurer of the company in 1899 and held the former position until his retirement in 1937. He was assistant treasurer until 1935.

▶ DANIEL M. SHEPARD, 47, vice-president in charge of production for Landers, Frary & Clark, New Britain, Conn., died in a local hospital on November 10, following an operation. He was born in Waterbury, Conn., and entered the company's purchasing department about 28 years ago, later becoming purchasing agent. He was appointed vice-president in 1931.

▶ WALTER H. NERNST, German physicist and inventor, died on November 18 at his country estate near Muskau, Germany, in his seventy-eighth year. The metallic filament lamp that bears his name made him world famous. His well-known "third law" of thermodynamics dealing with the behavior of matter at the approach of the absolute zero gained for him the 1920 Nobel prize for chemistry. In the course of his career he held chairs at Goettingen University and at Berlin University. He contributed to the technical press many papers on scientific, physical and electrochemical topics, based upon his original researches.

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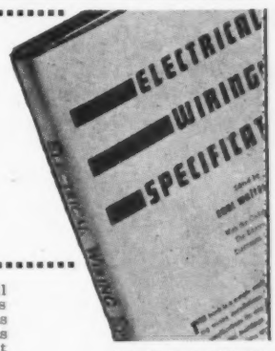

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MANUFACTURING-MARKETS

Turbine Shipments Rise 60 Percent

Deliveries from the South Philadelphia plant of the Westinghouse Electric & Manufacturing Co. totaled $21,300,000 in the first nine months of 1941, R. A. McCarty, vice-president in charge of the steam division, has announced. This represents an increase of more than 60 percent over deliveries in the same period of 1940, when $13,100,000 worth of steam turbines, gears and auxiliary apparatus was shipped.

At work on propulsion machinery for Navy fighting ships, cargo vessels and equipment for power plants and industry, the steam division had a backlog of orders valued at $148,000,000 on October 1. The backlog on October 1, 1940, was $67,000,000.

Some 6,600 persons are employed in the South Philadelphia works, nearly 60 percent more than the number on October 1, 1940.

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Allis-Chalmers Will Pay Defense Bonus

A defense bonus totaling over $1,000,000 to be paid Allis-Chalmers employees has been announced by Max W. Babb, company president. More than 21,000 employees will benefit at Allis-Chalmers plants at West Allis, Wis.; Norwood, Ohio; Pittsburgh, Pa.; Springfield, Ill.; LaCrosse, Wis.; LaPorte, Ind.; Boston, Mass.; Oxnard, Calif.

According to Mr. Babb, instead of paying this amount in one lump sum, it was decided to give a defense bonus of 2 cents an hour to all hourly employees and a comparable adjustment to salaried employees. The plan further provides for a 3 cents an hour defense bonus for all time and one-half overtime and 4 cents for all double-time.

"This means," said Mr. Babb, "that our employees will earn a defense bonus every working day that the plan is in force. Furthermore, it pays employees an additional bonus for the extra hours worked to speed production of vital defense orders in our plants."

•

DPC Executes New Lease Agreements

DPC has authorized an increase in its lease agreement with Combustion Engineering Co., Inc., New York, for additional facilities for plant at St. Louis, from $105,000 to $123,000. These facilities will be used in the manufacture of ordnance equipment.

Execution of a lease agreement with Copperweld Steel Co. for the construction and equipping of a plant at Warren, Ohio, to be used in the production of steel ingots has been authorized by DPC.

At the request of OPM, the Defense Plant Corporation has authorized the execution of a lease agreement with Babcock & Wilcox Tube Co. to provide for equipment at Beaver Falls, Pa., to be used in the production of alloy steel ingots, at a cost of approximately $969,050.

Execution of lease agreement has been authorized with Westinghouse Electric & Manufacturing Co. to provide for the construction and equipping of plants at Bloomfield, N. J., and Fairmont, W. Va., at a cost of approximately $1,408,768, to be used in the manufacture of radio equipment.

•

Delta-Star Gets Award

Water and Power Commission, Los Angeles, Calif., has awarded a contract to the Delta-Star Electric Co. at $28,323 for a quantity of disconnecting and ground switches (Specifications 3937); also, award for disconnecting switches at $3,181 (Specifications 3945).

Electric Equipment Output Sets Record

Demands of the national defense program have accelerated activity in the electrical equipment and machinery industry to the highest level on record, as reported by the Department of Commerce.

The present monthly production rate for the industry is approximately $300,000,000. This would indicate a total output for 1941 in excess of $3,500,000,000, which compares with $2,000,000,000 for 1940 and $2,400,000,000 in 1939, the previous record production. In only a few instances has the output of electrical products this year failed to double in volume over 1940, and in many cases production has tripled and quadrupled.

The principal increases have been in motors, generators, transmission and distribution equipment, the department states.

•

Nine Months' Orders '41 Exceed Whole of 1940

Value of new orders booked during the third quarter of 1941, as reported by 78 manufacturers of electrical goods, amounted to $629,027,540, compared with $581,674,663 for the second quarter of 1941, and $411,595,431 for the third quarter of 1940, according to the Bureau of the Census.

New orders booked for the first three quarters of 1941 totaled $1,764,817,671, which compares with $1,433,377,755 for the entire year 1940 and with $918,561,460 for the first three quarters of 1940.

•

Five-fold Expansion

Marmon-Herrington Co. recently completed expansion of its Indianapolis, Ind., Plant. The enlarged factory, which

now has five times its original floor space, is given over largely to assembly of military trucks and armored cars, although production of all-wheel drive commercial vehicles continues. A technical school for military tank operators of the armored force is being conducted at the factory.

•

Manufacturers Will Push Advertising Campaigns

Advertising appropriations and sales promotion campaigns of leading manufacturers are not being curtailed, a survey conducted by the Merchandise Mart, Chicago, indicates. The national defense program, it was shown, had created a rush of business.

Leading manufacturers representing nine industries, queried about their 1942 campaigns by Percy Wilson, managing director of the Mart, were unanimous in saying they planned to continue or even increase their advertising and promotion programs.

A number of the manufacturers reported that their factories were running at capacity, that they had a large backlog of orders and that the demand for their goods was in excess of their ability to meet it.

•

Reliance Electric Buys Cleveland Hobbing Unit

Reliance Electric & Engineering Co., Cleveland, has purchased the nearby plant of the Cleveland Hobbing Machine Co., which is expected to move its operations shortly into its new plant in Euclid, Ohio, permitting Reliance to take possession of the old plant by December 31.

Acquisition of the Cleveland Hobbing Machine plant will make available approximately 31,000 sq.ft. of floor space, according to the Reliance management. Part of this additional area will be used to relieve congestion in those assembly lines on which the smaller sizes of motors are handled. The rest of the newly acquired space will be used for storage area, replacing space now being rented by Reliance for this purpose.

New York Metal Prices

	Nov. 25,'41 Cents per Pound	Nov. 18,'41 Cents per Pound
Copper electrolytic	12.00*	12.00*
Lead, A. S. & R. Price	5.85	5.85
Antimony	14.00	14.00
Nickel, Ingot	35.00	35.00
Zinc Spot	8.64	8.64
Tin, Straits	52.00	52.00
Aluminum, 99 percent	15.00	15.00

*Delivery Connecticut Valley.

Field Reports on Business

General business activity is being sustained at a high level despite forced curtailment in certain lines and restrictions in others. A wide variety of electrical equipment is being bought. Consumer buying for the Christmas season commenced with great gusto after the Thanksgiving holiday.

NEW ENGLAND

Hartford Electric Light has purchased three 45,000-kva. G.E. bus tie transformers for the South Meadow station. Power sales reported by this company show the strong trend in defense activity that prevails within the area served by its system. October power sales were 9.6 percent over September and 29 percent above October, 1940.

Electric furnace manufacturers are operating at record levels. A prominent manufacturer in this area plans to move into larger quarters about the first of 1942 owing to an increase in foreign orders for electric heat-treating furnaces for production of munitions and machinery. Infra-red applications are attracting attention and sales of equipment are moving ahead. Graton & Knight, Worcester, have bought a 60-kw. Fostoria infra-red installation for drying leather, and Textile Thread Co., Watertown, Mass., has ordered a 15-kw. Fostoria outfit for thread drying. B. F. Sturtevant Co., Hyde Park, Mass., reports interest in air-conditioning for the preservation of books and documents in museums and public archives. This company reports the installation of motor-driven ventilating fans in the new lightweight ocean going freighters now being constructed.

Recent awards announced by OPM include orders for wire, capacitors, fuel pumps and panelboards. Contracts for housing and recreation facilities at various army posts in New England continue to offer opportunities for sales of good volumes of supplies for wiring for light and power. Platt Construction Co., Inc., Newport, R. I., has been awarded a contract totaling $145,000 for the construction of a recreation center at Newport Naval Base.

PACIFIC COAST

Defense industrial developments featured the past week. Excavation has begun of the Troutdale, Ore., plant of Aluminum Co. of America. Five million dollars each has been granted to Standard Oil and Union Oil for additions to their Richmond and Los Angeles refineries, respectively. Additions are planned to steel plants of Bethlehem at Los Angeles and Columbia at Provo, Utah.

Recent varied awards and low bids include $206,920 for G.E. circuit breakers; $158,004 for Westinghouse breakers and arresters, and $148,000 for Bowie disconnecting switches, all awarded for Grand Coulee plant; a $559,785 G.E. low bid covering three 25,000-kva. transformers for Keswick plant of Central Valley project; Colorado-Big Thompson project low bids of $105,550 Allis-Chalmers, 115-kv. transformers; $54,698 for Pennsylvania 69-kv. transformers, and $37,800 for Allis-Chalmers 69-kv. circuit breakers; 10 miles of copper trolley wire for San Francisco; $56,565 for distribution lines at Santa Ana Air Corps Center; $56,905 for Westinghouse carrier current equipment for Grand Coulee, and $15,721 for six 25-kv. gas-electric generating sets for Honolulu. Copper shortage is causing keen concern and copper wire sales have been made 100 percent defense, stocks being otherwise irreplaceable.

On the eve of season of real holiday buying wholesalers report a fair percentage of deliveries, but an unlucky prospect for dealers who have not over-ordered on that assumption. Appliance orders have been plainly pyramided, but the general situation is sufficient insurance against overdelivery, and defense housing, among other reasons, assures an almost steady continuance of demand into 1942.

NEW YORK

Industry and trade related to national defense are operating as close to capacity as is possible, what with raw material shortages and labor difficulties. Business dependent on civilian demand tends toward contraction, or at best is reporting gains of less than normal seasonal size.

Engineering construction awards for the short week due to the early closing for the Thanksgiving Day holiday totaled $64,100,000, a decrease of 14 percent from the volume reported for the corresponding 1940 week by *Engineering News-Record*. The week's total brings 1941 construction to $5,488,679,000, an increase of 57 percent over the volume for the 47-week period last year.

On October 1, 1941, the value of defense construction—completed, in progress, and scheduled—amounted to $7,958,203,000, the bureau of research and statistics, OPM, reported last week.

Household goods men predict that retail business in stoves, electric refrigerators, vacuum cleaners, toasters and related items may top last year's season in many cities, even though installment credit terms are stiffer. The completion of new homes in the busy defense industry cities is providing steadily customers for major household essentials.

CHICAGO

Consumer buying for the Christmas season commenced with an unprecedented rush immediately after the Thanksgiving holiday. If the trend continues merchants anticipate a record-breaking sales volume. Shortages of some electric appliances have been reported by wholesalers in recent weeks and it is doubtful if sufficient replacements can be secured to meet the demand.

With emphasis on defense production, industrial activity continues at top speed. Carnegie-Illinois Steel Corp. will reopen the two furnaces which were shut down last week because of the impending coal shortage. So far this year $306,738,025 has been spent here for plant expansions, compared with $91,544,600 in the same period last year. The recent trend of new building is downward, however. For the week ended November 13 the city of Chicago issued 69 permits, as against 88 the previous week and 100 in the comparable week of 1940.

Defense Plant Corporation last week authorized a contract with the Youngstown Sheet & Tube Co. for construction of two new alloy steel furnaces at Indiana Harbor at a cost of approximately $1,900,000. Defense contracts totaling $11,743,239 were awarded to 121 firms in this area last week. Orders for electrical equipment included Rauland Corp., transmitting apparatus, $453,112; Automatic Transportation Co., electric trucks, $66,960; J. P. Seeburg Corp., control assembly, $343,150.

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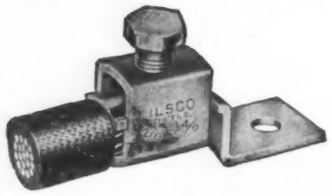

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Sales Opportunities

GLEN LYN, VA.—Appalachian Electric Power Co., Roanoke, Va., has approved plans for expansion in steam-electric generating plant at Glen Lyn, and will begin erection soon of multi-story addition for extensions in boiler and turbine departments. Equipment will be installed for increased capacity. Switchyard will be enlarged and extensions made in transmission lines. No estimate of cost announced.

LOS ANGELES, CALIF.—Purchasing Agent, Los Angeles Water and Power Bureau, 205 South Broadway, receives bids until December 8 for pilot wire protective relay equipment, complete with insulating transformers and automatic pilot wire supervisory apparatus, for protection of two 132-kv., 60-cycle transmission lines between receiving substation "C" and new steam-electric power plant in harbor district (Specifications 4004). Also, until December 8 for iron and steel piping system for Harbor steam-electric station, Wilmington, including main steam, exhaust steam and boiler feed-water piping (Specifications 3996).

DETROIT, MICH.—Bohn Aluminum & Brass Corp., Lafayette Building, Detroit, manufacturer of aluminum, brass, bronze and other metal castings and forgings, plans two large plants for extrusion of aluminum products for government, to be located at Adrian, Mich., and Los Angeles, Calif., respectively. Installation will include motors and controls, switchgear, transformers and accessories, fluorescent lighting system, conveyors and other equipment. Each plant will comprise several large one and multi-story units, with power substation for central station power service. Adrian works are estimated to cost $3,935,000, of which approximately $2,520,000 will be expended for machinery and operating facilities; Los Angeles plant, of larger size, will cost about $5,538,000, of which $3,785,000 will be used for machinery and operating equipment. Total fund of $9,473,000 will be furnished by Defense Plant Corporation, Washington, D. C., a federal agency, for projects.

NEW ULM, MINN.—Water and Light Department has authorized plans for expansion in municipal power plant, to include installation of new turbine generator unit and auxiliary equipment. Surveys and estimates of cost will be made by Ralph D. Thomas & Associates, 1200 Second Avenue, South, Minneapolis, Minn., consulting engineers.

FOREST, OHIO—Ohio Power Co., Tiffin, Ohio, has authorized immediate construction of new power substation at Forest, estimated to cost close to $100,000, with transformers, switchgear and auxiliary equipment. Work will include extensions in transmission lines to substation site.

SAVANNAH, GA.—Savannah Electric & Power Co. has recently secured permission to construct new 110,000-volt transmission line through Chatham County and work is scheduled to be carried out at once. This is part of high-tension line construction to tie in with system of Georgia Power Co., Atlanta, Ga. Total line will approximate 70 miles.

WARREN, OHIO—Copperweld Steel Co., Glassport, Pa., manufacturer of copper and bronze wire rods, strand, etc., plans installation of heavy-duty motors and controls, regulators, switchgear, transformers and accessories, industrial lighting system, conveyors, electric hoists and other equipment in new plant at Warren, for production for government. Two electric melting furnace units and auxiliary equipment will be installed, with rating of about 85,000 tons per annum. Plant will comprise several large one-story buildings and is estimated to cost about $4,000,000. Fund in that amount will be secured from Defense Plant Corporation, Washington, D. C., a federal agency, for project.

MISHAWAKA, IND.—Indiana & Michigan Electric Co., South Bend, Ind., will begin work soon on addition to Twin Branch steam-electric generating station at Mishawaka, with installation of additional equipment for increased capacity. No estimate of cost announced. Completion is scheduled in fall of 1942. Project will include extensions in transmission lines in Mishawaka district.

CEDAR RAPIDS, IOWA—Iowa Electric Light & Power Co., Cedar Rapids, plans extensions in transmission lines in parts of Johnson, Benton and Linn Counties. Permission has been granted and work is scheduled to be carried out at once.

HINTON, W. VA.—United States Engineer Office, Huntington, W. Va., receives bids until December 16 for construction of Bluestone dam and appurtenant works on New River, near Hinton, including 200,000 lb. of electrical conduit, oil-pressure and sump pumps, sluice gates, crest gates and accessories, valves, etc. (Circular 81). (Plans are under way for hydroelectric generating station to be located at same place, and for which bids will be asked in near future, estimated to cost about $8,000,000 out of total expenditure of approximately $22,000,000 for project).

BENDIX, N. J.—Pioneer Instrument Division, Bendix Aviation Corp., Bendix, manufacturer of aircraft instruments and other precision apparatus, plans installation of motors and controls, switchgear, transformers and accessories, fluorescent lighting system, duct lines, conveyors and other equipment in new local plant, in vicinity of present works, for production for government. It will consist of a main one-story unit and several auxiliary buildings. Cost estimated about $1,000,000, with fund in that amount to be secured through Defense Plant Corporation, Washington, D. C., a federal agency, for project.

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Wire Contract Let

Bureau of Reclamation, Denver, Colo., has awarded a contract to the Graybar Electric Co., New York, at $13,708 for a quantity of copper wire for transmission lines for Minidoka project, Idaho.

•

Equipment Contracts Let

City Commission, Traverse City, Mich., has awarded a contract to Elliott Co., Jeannette, Pa., for a 2,500-kw. turbine-generator unit for installation in municipal power plant at $67,316. Also, an award to C. H. Wheeler Manufacturing Co., Philadelphia, for a 3,840-sq.ft. surface condenser at $22,350. Entire project is estimated to cost approximately $100,000.

Chickasaw Solves Unusual Condensing Problems

[*Continued from page 55*]

Boiler design is for a continuous maximum capacity of 400,000 lb. of steam per hour. It is the regular three-drum, bent-tube boiler, to which has been added a dry drum. The superheater is equipped with by-pass temperature control to maintain a constant total steam temperature of 860 deg. F. from 240,000 to 400,000 lb. steam per hour. The furnace is completely water-cooled, using fin-tube construction, and is equipped with dry bottom.

There is no economizer, the only heat recovery equipment being a Ljungstrom air heater. The heating surfaces in the boiler and related equipment are boiler, 18,000 sq.ft.; superheater, 9,980 sq.ft.; furnace, 6,221 sq.ft.; air heater, 45,100 sq.ft.

Three Raymond pulverizers supply coal to twelve type "T" burners (tangential firing), three of which are located in each of the four corners of the furnace. Each pulverizer has a maximum capacity of 21,800 lb. coal per hour, having a moisture content of 10 percent and a grindability of 50 (Hardgrove scale).

Mechanical draft equipment consists of one forced-draft fan and one induced-draft fan, each of which is equipped with vane control and driven by two motors. The forced-draft fan has a maximum capacity of 140,000 c.f.m. air at 100 deg. F. against 14-in. static pressure when operating at 1,180 r.p.m. The induced-draft fan is designed for a maximum delivery of 250,000 c.f.m. gas at 450 deg. F. against 15 5-in. static pressure when operating at 1,180 r.p.m.

Feedwater Cycle

Three closed heaters and a deaerator comprise the feedwater cycle. All closed heaters are four-pass design and are located vertically in the condenser pit. The deaerating heater is equipped with a separate storage tank of 70,000 gal. water capacity, which acts as a surge tank for the feedwater cycle. The deaerator is located on the fan floor of the boiler house in order to provide the maximum positive suction head on the boiler feed pump.

Two boiler feed pumps are installed, each having a capacity of 970 g.p.m. water at 316 deg. F. against 2,425 ft. net head, when operating at 3,600 r.p.m. synchronous speed.

Pilot-operated valves are installed for heater drainers. An attended operating station has been eliminated by locating the feedwater regulator on the operating floor level and by providing the boiler room engineer with two separate remote water level indicators and a boiler level recorder.

Five extraction points for feedwater heating are provided in the 3,600-r.p.m. tandem-compound Westinghouse turbo-generator. However, only four of the points are used in the feedwater cycle.

Coal and Ash Handling

Provision is made in the coal-handling system for delivery of fuel to the plant by rail or by barge. The system is designed to handle 150 tons of coal per hour with provision to increase the capacity to 200 tons per hour.

Coal is delivered from the track hopper to storage or to the boiler room by a system of 24-in. belt conveyors. Coal is not crushed before being placed in storage, but is reduced to 1-in. size and smaller before being delivered to the boiler room coal bunker. Bunker capacity of 500 tons (24 hours' supply at maximum plant rating) is provided, and coal scales are installed between the bunker and pulverizers for accurately weighing the coal burned.

Coal is handled in and out of storage by means of angle-dozers and carryalls driven by Diesel tractors. The layout contemplates the future installation of a drag scraper should the storage system expand to a point exceeding the economical capacity of tractor-driven equipment.

Ash is removed from the dry furnace bottom hopper by means of a sluicing system. It is sluiced into an ash dump located adjacent to but outside of the boiler house. From this point it is pumped approximately 1,000 ft. distant, where it is used to fill low and swampy areas.

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Board Denies Gary Plea

Indiana Public Service Commission has denied a petition by the city of Gary, Ind., for a rehearing of the order which permitted the Northern Indiana Public Service Co. to purchase the stock of the Gary Heat, Light & Water Co. for approximately $10,000,000.

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- *on corner turns, wire can be dropped into lower groove . . . increasing strength of pin and reducing possibility of both pin-bending and pin-breakage.*
- *has long leakage path.*
- *has high impact strength.*

• Data sheets ready

OWENS-ILLINOIS

HEMINGRAY DIVISION, MUNCIE, INDIANA

Pick-Up and Resistance of Counterpoise Systems

[*Continued from page 57*]

cent. The tower resistance was 20 ohms. From the current distribution the apparent resistance of the counterpoise system is about 3 ohms. No measurement was taken of the counterpoise resistance in this section.

The continuous counterpoise system appears quite efficient, its pick-up extending in some cases over a length of approximately 2 miles. Its apparent resistance is very low, but somewhat higher than its measured resistance. This is reasonable, as the measured resistance involves the whole counterpoise length, while the apparent resistance value involves only that portion under the cloud or affected by the particular stroke.

Radial and Rods

On one system there is used a combination of two 250-ft. counterpoise wires, extending parallel with the transmission line from diagonally opposite corners, say corners 1 and 4, similar to Fig. 1(b), except that the two right angle wires are omitted. In addition, from two to four rods are driven in the space inclosed by the tower legs. In case two rods are used they are connected to legs 2 and 3. If more rods are used they are connected one rod per leg.

Readings of current were taken in the tower legs above ground, in both counterpoise wires, in all rods and in the tower legs below the ground and below the point of connection of counterpoise and rods.

In one case, with the two 250-ft. counterpoise wires and four driven rods 45, 104, 40 and 60 ft. deep, the division of current and the measured resistance was as follows:

	Current Division in Percent	Measured Resistance, Ohms
Tower footings....	9.6	50
Counterpoise	55.6	7.5
Ground rods.....	34.8	33

In a second case, with the two 250-ft. counterpoise wires and two driven rods 60 and 53 ft. deep, the division of current and measured resistance was as follows:

	Current Division in Percent	Measured Resistance, Ohms
Tower footings...	17	50
Counterpoise	41	8
Ground rods.....	42	23

In the first case the ground rod current is higher and in the second case the counterpoise current is lower than indicated by the resistance, based on tower footing current and resistance as reference.

Continuous Right Angle and Rods

On one system the surface soil was sand and rods were deep-driven to clay or loam. An experimental installation was made employing three different combinations:

(a) Continuous counterpoise and two right-angle counterpoise wires, Fig. 3(a).

(b) Continuous counterpoise and driven-rods, Fig. 3(b).

(c) Right-angle counterpoise and driven rods, Fig. 3(c).

In one case a stroke affected the line in the region equipped as in Fig. 3(a). The distance between towers was about 500 ft. and the two right-angle wires were each 250 ft., so that each tower had associated with it practically equal lengths of both types of wire. The current pick-up was distributed as follows: Continuous counterpoise, 38 percent, right angle counterpoise 43 percent and tower footing by subtraction 19 percent. The average measured resistance of the fourteen tower footings concerned was 637 ohms, or 45.5 ohms with all footings in multiple. From the distribution of current, this would give an apparent continuous counterpoise resistance of about 23 ohms and resistance of the right angle counterpoise system of 20 ohms.

With the arrangement of Fig. 3(b) two strokes occurred. In case 1 four towers were involved and in case 2 eight towers. In the table below the resistance given for the footings and rods is for four and eight towers respectively in multiple. The current pick-up was as follows, the tower footing current being found by subtraction:

Percent Current Pick-up	Case 1	Case 2
Driven rods.....	81	87
Counterpoise	17.5	12
Tower footings.....	1.5	1

Resistance, Ohms	Case 1	Case 2
Rods measured.....	3.4	1.4
Counterpoise estimated.....	17.8	6.9
Footings measured.....	208	83

With the arrangement of Fig. 3(c), readings were obtained in two cases. In case 1 three towers were involved and in case 2 twelve towers. In the table below the resistance given for the footings and rods is for three and twelve towers respectively in multiple. The current pick-up was as follows,

the tower footing current being found by subtraction:

Percent Current Pick-up

	Case 1	Case 2
Driven rods	77	58
Counterpoise	22	41
Tower footings	1	1

Resistance, Ohms

	Case 1	Case 2
Rods measured	4.3	0.9
Counterpoise estimated	12	1.6
Footings measured	269	67

Conclusions

The current pick-up of counterpoise wires, both radial and continuous, and driven rods is substantially in accordance with their resistance values.

A comparison of the relative efficiency of the continuous counterpoise and radial counterpoise arrangements has been obtained on one system. In 2.6 miles of line equipped with two overhead ground wires and a continuous counterpoise wire arranged as in Fig. 2(c) no flashovers have occurred in twelve years, although tower currents up to 80,000 amp. have been measured in this section. In the three years before the counterpoise was installed a total of 29 flashovers occurred in this section. In 25.0 miles of line equipped with two overhead ground wires and radial counterpoise wires arranged as in Fig. 1(a) and 1(c) in eleven years the flashovers averaged about 1.5 flashovers per 100 circuit-miles per year.

These data would indicate that for these two radial counterpoise arrangements at least the continuous counterpoise is more efficient. On the other hand, the data given for the arrangement of Fig. 3(a) show the radial system to be as efficient as the continuous system when of comparable length, that is, of comparable resistance.

The data on driven rods show them to be very efficient when of sufficient depth to give low resistance.

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G.E. Suggestion Awards

The amount of awards paid employees in all works of the General Electric Co. under the suggestion system for the third quarter of the year was 36 percent higher than for the corresponding three months of 1940. During this period $23,698 was paid out for adopted suggestions as contrasted with $17,476 paid out in 1940. There was an increase of 37 percent in the number of suggestions submitted.

Glareless Illumination for Instrument Boards

[*Continued from page 52*]

wealth Edison Company has for these cases worked out the metallic mirror idea previously mentioned. All of these schemes are shown in the sketches accompanying this article.

In recent years miniature lamps, Lucite rods and, very recently, fluorescent lamps have been installed inside meter cases to overcome some of the difficulties enumerated. In some instances this is unavoidable, but such a plan is very expensive where a large number of meters are involved. Also, heat is liberated by the lamps within the case and tends to dry out the ink in recording meters and interferes with the lubrication of the mechanisms that are employed. A defect that is often apparent with individual case lights is that the lamps are exposed either partially or completely, causing glare. Where they are not exposed there is apt to be an illuminated area close to the lamps that is very bright and "spotty," while the dial or paper is in the shadow.

Lucite Rods Tried

It seems difficult to obtain the clearances necessary for a good lighting job with individual meter lights. The recording paper is usually quite close to the glass front or the meter mechanism interferes. To overcome this handicap, Lucite rods have been used. The lamp is placed well back in the meter and a certain amount of the lamp flux impinges on the inner end of the Lucite rod and travels through it as through a pipe following the bends to the further extremity, where it emerges. Difficulties with this arrangement have been twofold: First, the solid angle of flux subtended by the end of the rod is necessarily very small and, therefore, the portion of the lamp's total flux used for illumination is quite limited. Second, Lucite rods are not very rigid and they tend to sag into positions where the rod becomes exposed or where the emitted flux is not useful.

In all individual meter lighting, by whatever means, the interior of the case should be surfaced with a durable white diffusing paint so that as much of the light as possible is reflected against the dial.

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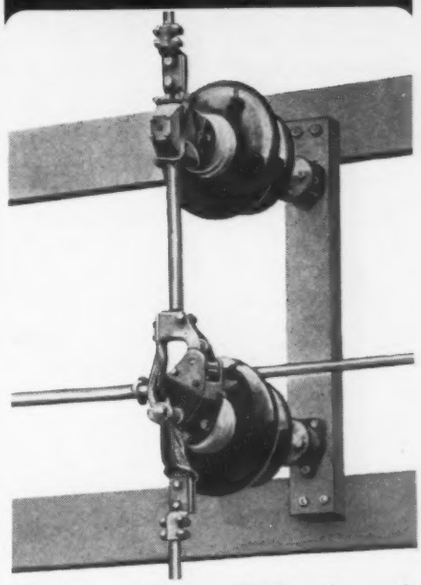

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Contact and hinge assemblies both provide full ice protection. All control arms and cranks provide ice-breaking leverages that assure positive operation in freezing weather.

Southern States' 57A is so designed that it may be converted from a right-hand to a left-hand switch in the field. No extra or exchange parts are needed.

NEMA and AIEE Specifications are met with ample safety factor throughout in the design and construction of Southern States' 57A Side-break Disconnecting Switches. As a matter of fact, all Southern States' standard electrical equipment complies with these specifications.

Ask your Southern States' representative for further information or write for Bulletin 365.

Southern States

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Representatives In Principal Cities

Street Lighting in Lorain Follows Progressive Plan

[*Continued from page 47*]

ure due to open secondary circuits.

Grounding switches were also installed on secondary legs of the transformers.

Permanent grounds were installed at the middle point of the old loop circuits.

Care was taken in the design of the circuits to limit the load to 25 kw. per circuit.

There are 26 series circuits in all.

Reasons for the above design follow:

1. One-half full load operating voltage of constant current transformer due to grounded series circuits.
2. Use of low-voltage insulation and smaller diameter cable and fixture wire, also smaller insulators, etc.
3. Minimum length of overhead and underground wire and cable, and a minimum investment.
4. Novalux protector eliminates hazard to public of open-circuit voltage on fallen wires.
5. Grounding switches permit immediate location of open secondary leg and restoration of service to one-half the circuit while the open leg is being patrolled. This minimizes the time required for patrolling and restoring complete service.

In order further to reduce the operating voltage on circuits with internally wired ornamental fixtures the 20-amp. straight series system is used.

Distribution Problems in Cantonments

[*Continued from page 43*]

transformer units) and the units placed in a row side by side and spanning these walls. Between the transformers the walls are bridged with a loose plank floor. As the 4-kv. leads emerge from the bottom of the units these cables, with control cables, are racked along the insides of the walls, at the surfaces of which all conduits end. A 5-ft. headroom is maintained under the transformers between the walls, and the effect is created of a shallow basement or vault, giving ample space for cable pulling, splicing, ventilation and inspection. The ends of this space are closed in with brick and a crushed rock floor with dry well. Metal-clad switchgear is set on a similar foundation. From the walls of the footing conduits were run to riser poles for connection with the feeders, a spare cable being provided to a separate riser pole so located that an overhead span can quickly be strung from it to any of the feeder poles in case of cable failure. Transformer and substation bus protection is differential between total incoming and outgoing current.

In a recent typical month the demand was 2,245 kw. and the energy consumption 880,000 kw.-hr., giving 392 hours' use of demand. This was accomplished by operating pumps, compressors, etc., during off-peak periods. Average power factor was approximately 90 percent. A survey of distribution transformer loads indicated that ample reserve capacity exists and that no transformers were loaded above rating.

Surveys Reveal Network Load Conditions

[*Continued from page 50*]

are supplemented by computed values and demand meter values and transferred to the sketch shown in the accompanying illustration. To simplify this sketch all services are shown as a single load at each manhole. In all cases but three loads connected out of vaults are assumed connected out of the adjacent manhole. This simplifies the application of Kirchhoff's law. Although the algebraic sum of currents at junctions did not always add up to zero, they were sufficiently close to identify direction of flow. Where the cable or transformer rating is approached or exceeded and such conditions of algebraic unbalance exist the area on the sketch is circled and careful computations and analyses are made. In such cases network reduction methods are used to determine division of load to each tap and the final division of load is determined by superposition.

Since the cable sections and transformers are of several types and sizes, with resultant different current ratings, another sketch is marked showing the percent loading rather than actual current loads. This sketch is also shown.

Load conditions shown graphically on the final sketch simplify determination of proper remedial measures for overloads, since the entire network system is pictured as a whole for each condition of primary supply. Underloaded, as well as overloaded, areas are shown, thus relieving certain areas from further consideration. Overloaded areas are sometimes circled and checked by further computations before definite improvements are requisitioned.

LETTER TO THE EDITOR

Transformer Data

To the Editor of ELECTRICAL WORLD:

In my article "Wire and Transformer Size to Prevent Motor-Start Flicker" (ELECTRICAL WORLD, October 4, 1941) obsolete figures for percent reactance of Line Material Company transformers were given. The correct figures are as follows:

Kva.	% *R*	% *X*	Kva.	% *R*	% *X*
1½	2.8	1.33	25	1.47	2.50
3	2.53	1.61	37½	1.27	2.61
5	2.3	1.93	50	1.23	2.62
7½	2.08	2.02	75	1.15	4.46
10	2.0	2.1	100	1.13	4.46
15	1.65	2.39			

S. LUBIN,
Rural Electrification Administration,
Washington, D. C.

To the Editor of ELECTRICAL WORLD:

In the article by C. F. Avila and myself on "Balancing Parallel Transformers," ELECTRICAL WORLD, November 1, 1941, page 116, paragraph 1, the last sentence should read, in part, "the transformer carrying the *least* share of the load," etc. In the first sentence of the second paragraph, same page, transformer B should have 3.5 percent impedance and not 5 percent as printed.

R. C. GHEN,
Boston Edison Co.

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Recent Rate Changes

CAZENOVIA ELECTRIC CO. has been granted permission by the New York Public Service Commission to put into effect new schedules which will save electric consumers approximately $660 per annum. The new rate became effective November 1 for the village of Cazenovia and surrounding towns in Madison County.

ADAMS ELECTRIC LIGHT CO. has been authorized by the New York Public Service Commission to put into effect revised rates for electricity which will result in savings of approximately $700 annually to its customers in the villages of Adams, Ellisburg and Mannsville and towns of Adams, Ellisburg, Rodman and Henderson. The new rates will become effective December 1.

ILLINOIS COMMERCE COMMISSION has announced that rate changes effective during the month of October resulted in an estimated decrease of $35,879 in annual operating revenues. Electric reductions contributed only $7,612 to this total.

SOLVAY, N. Y., municipal electric plant has been permitted by the state Public Service Commission to put into effect revised rates for electricity which will result in savings of approximately $4,850 annually to residential and commercial consumers within the village and in a portion of the town of Geddes, Onondaga County. The new rates became effective November 15. The bulk of the reduction will accrue to residential consumers.

Kitchen Planning Service as a Load Builder

[*Continued from page 59*]

1. It is desirable to obtain a free hand sketch of existing floor plan, including location and size of present major appliances, doors and windows. The engineering drawing developed from this sketch becomes the basis of the entire kitchen planning operation.

2. Locate the refrigerator near the service entrance door (which is where "raw material" enters the home) with the door opening next to counter, or table. If one side of the refrigerator is to be exposed in a complete cabinet-equipped kitchen a space 33 in. in width and a minimum of 3 in. above refrigerator to wall cabinet is necessary for ventilation. If the refrigerator is placed in a corner a space of 36 in. is advisable, which will be ample space for any size refrigerator up to a modern 9 cu.ft. model.

3. The range should be placed near the dining room entrance, but not with the surface units in the direct path of traffic. An adjoined base cabinet, with counter, or small table is recommended to eliminate the possibilities of tipping pans of hot water, food or grease. This will put into actual practice all the safety features of electric cooking (see photo).

4. Range surface units also should be separated from corner walls by a counter or table to eliminate splashing on the wall, and this will provide accessibility to and full use of all surface units in food preparation. It is advisable also to separate the range from the adjacent cabinet counter by 4 in., particularly on the surface unit end for easy cleaning, or to recommend the installation of a metal union strip between the range and counter to provide a semi-continuous top.

Wall Cabinet Installation

If wall cabinets are to be installed directly above the range cooking top, a minimum clear space of 18 in. will be satisfactory, provided an exhaust fan is installed near the unit in the wall or ceiling. On the other hand, if a fan is not considered, it is advisable to recommend the installation of the cabinet not less than 22 in. from the cooking top. Thus the accumulations from surface and oven cooking will be kept at a minimum.

5. Base storage cabinets with counter tops are normally set 36 in. from the floor, similar to the height of sink and range. It is, therefore, advisable to check space between this counter and underside of wall cabinet to make certain that it is not less than 16 in. nor more than 18 in., depending on the height of the housewife. This arrangement will provide for ample storage and use of the average size electric food mixer without removing it from normal position. Heavier type mixers will require additional height.

Skillful, experienced attention should be given to the location of major electric appliances, and the installation of the proper size and type of units will result in a kitchen of new beauty, greater usefulness, better appliance performance and greater value to the home maker. To the utility's sales department, it means a customer who will be proud of her workshop and display her modern kitchen to all her friends. Because 75 percent of the total residential service is required through the ever-increasing use of the major kitchen appliances, the importance of the development of kitchen planning from a load-building standpoint is evident.

Public Power Trust Out to Get Krug

[*Continued from page 62*]

hand of the driver isn't over by any means. So far Krug has held his position, and there is little to indicate any basic upheaval in the immediate future. Nelson is completely in support of Krug, and Nelson has shown himself to be unusually immune to pressure.

But, as with a steam boiler, there is a limit to the amount of pressure which can be applied before an explosion results. Any agency which has millions to parcel out in Congressional districts, particularly among farm voters, has a forceful entree to Congressional halls.

There has been talk in Washington that Nelson will be replaced as director of priorities around the first of the year. It's just talk, today. There also are recurring rumors linking this man and that with a Presidential edict setting up an over-all power "co-ordinator" apart from OPM. This also is in the talk stage now. But with a few isolated, yet specific, examples alleging discrimination against REA, the public power trusters are capable of building a big volcano.

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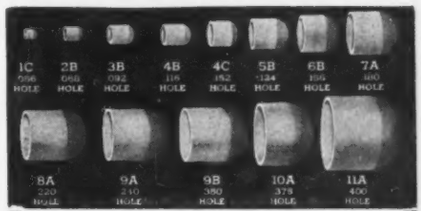

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